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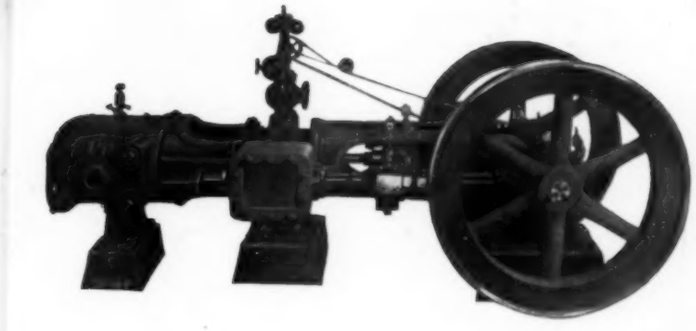

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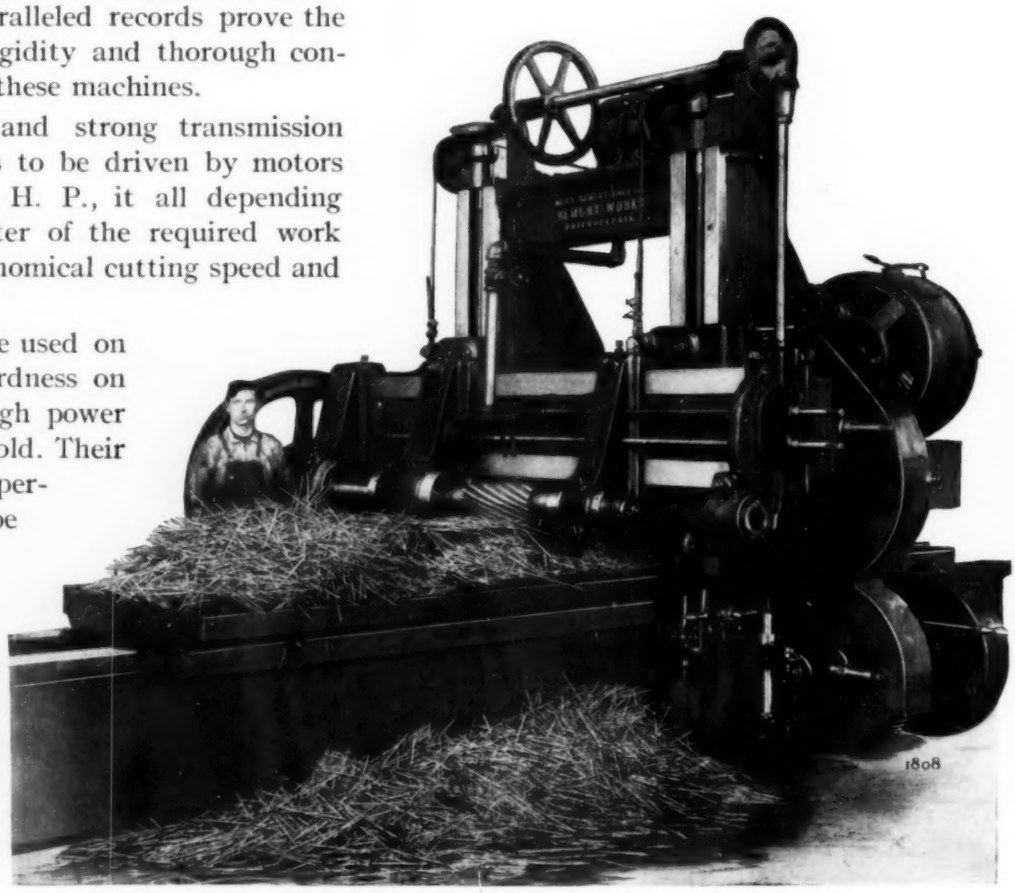

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(*See pages* 43, 44, 45, 46 and 47)

Die Work for Vacuum Cleaner Parts

By S. B. Redfield

An unusually large variety of punches and dies for stamping out many of the parts of a vacuum cleaner.

Stamping and forming the parts of a caster, the connecting rod, piston bracket, piston-valve plate ring and a wing nut, the latter from half-inch steel stock.

Making a flat tube and punching leather valve sheets.

That the vacuum cleaner is one of the modern inventions which is rapidly becoming a necessity, is well recognized, and with the end in view of producing a mechanical and reliable piece of machinery at as reasonable a price as possible, the Keller Manufacturing Company, of Philadelphia, Penn., which manufactures the Keller-Santo vacuum cleaners, has gone extensively into the adoption of special dies and tools. Some of the many interesting dies which they are using to produce the parts of their machines are shown in the accompanying halftones. It should be said that in some cases the number of operations shown could be reduced if the presses in use at the time these dies were constructed had been of greater power.

Stamping a Caster

Fig. 1 shows one of the most extended die sets, these all being used in the making of one thing; that is, the roller caster, upon three of which the machine stands. The caster is in three main parts, all made by stamping and pressing; the roller itself being made of fiber disks bound tightly together by a steel shell rivet and washers, and afterward ground to a perfectly smooth surface, giving the effect of a solid piece of fiber. In the halftone referred to, *A* is the blanking die, with the punch just to the left of it. The piece produced is directly in front of *A*, and the scrap metal is shown at *X*. This metal is, itself, what was left over from a previous stamping operation for another portion of the machine, so that the ultimate waste of metal is exceedingly small.

After blanking, the piece is put into the die *B*, and the three holes punched, as shown. It next passes to *C*, where it is cupped into the shape shown just in front of *C*. To produce this, the central portion of the die drops down, pushing the side wings up, a rubber buffer giving the necessary resistance. Two spring stripper fingers are also seen above this die.

After being cupped, it is necessary to crimp the two wings as at *G*. This is done in the die *D*, after being fitted over the flattened ball *F* of the wedge block shown. This half ball is spread by means of the wedge, so as to grip the yet uncrimped work, and it is then placed over the die *D*. Next, the two hinged pieces *E*, are swung inward, and then pushed downward and inward, by the press head, forming the crimp in the two wings of the work.

This completes the yoke of the caster, and the die *H* performs the blanking of the base. This blank is then put over the punch *Y*, and the die *J* is brought down upon it to give it the cup shape. *J'* sharpens up the base of the cup before the piece is taken to the die *K*, where it is crimped as shown by the piece in front of *K*. Here, a rubber buffer allows the ring portion of *K* to drop downward, guided by the four blocks shown; also a knockout, operated by the two pull rods and cross yoke, frees the piece from the punch. At *L*, this piece coming from *K* is trimmed, the two plates *Z* serving to locate the work over the die. Punching of the five holes is performed in *M*.

This completes the base plate, and the next operation is shown at *N*; that is, the making of the washers which are used in riveting the base to the yoke. These washers, of course, are made by first punching the center hole, and then using a second, piloted punch to center and punch out the complete washer, truly concentric with the hole in the middle. At *O* is seen the automatic feeding mechanism of a punch and die for swaging out these washers to remove any crimping. The bent lever is operated by the motion of the press head, feeding one washer from the tube magazine back of it, in which the newly punched washers are piled, bringing them forward through a slot, to the punch shown standing at the left of *O*.

At *P*, the binding washers are stamped out in a manner similar to *N*, these washers being those which bind together the fiber disks of the roller. At *Q*, these washers are swaged down to round the edges of one face. The center of the die *Q* sinks down on a rubber buffer,

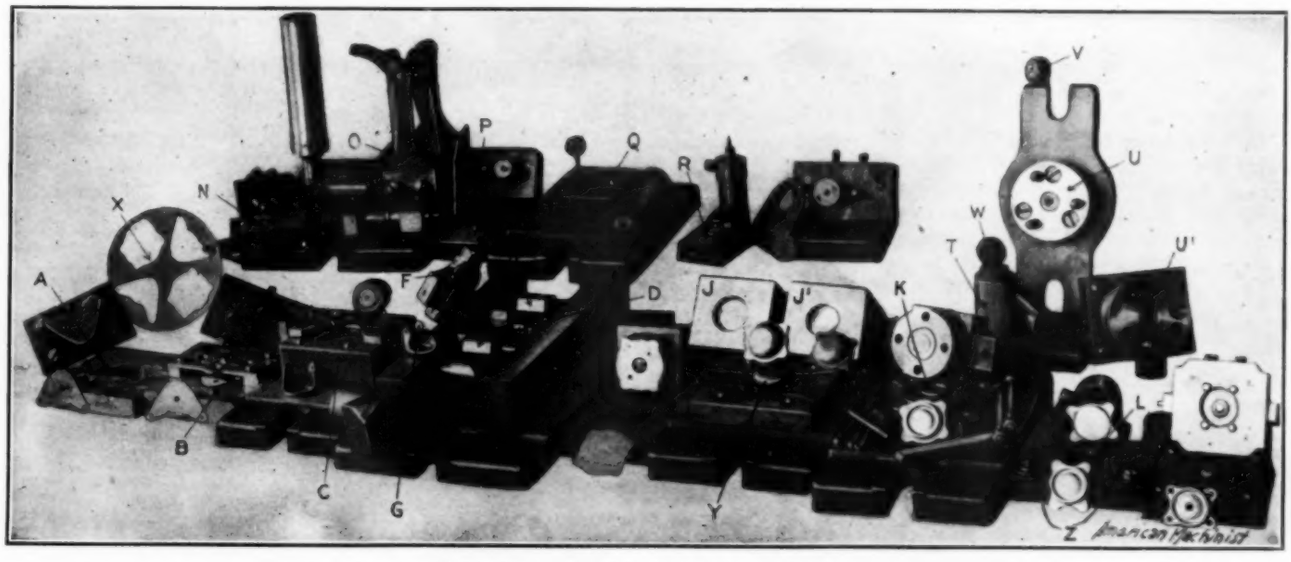

Fig. 1. Punches and Dies for a Caster

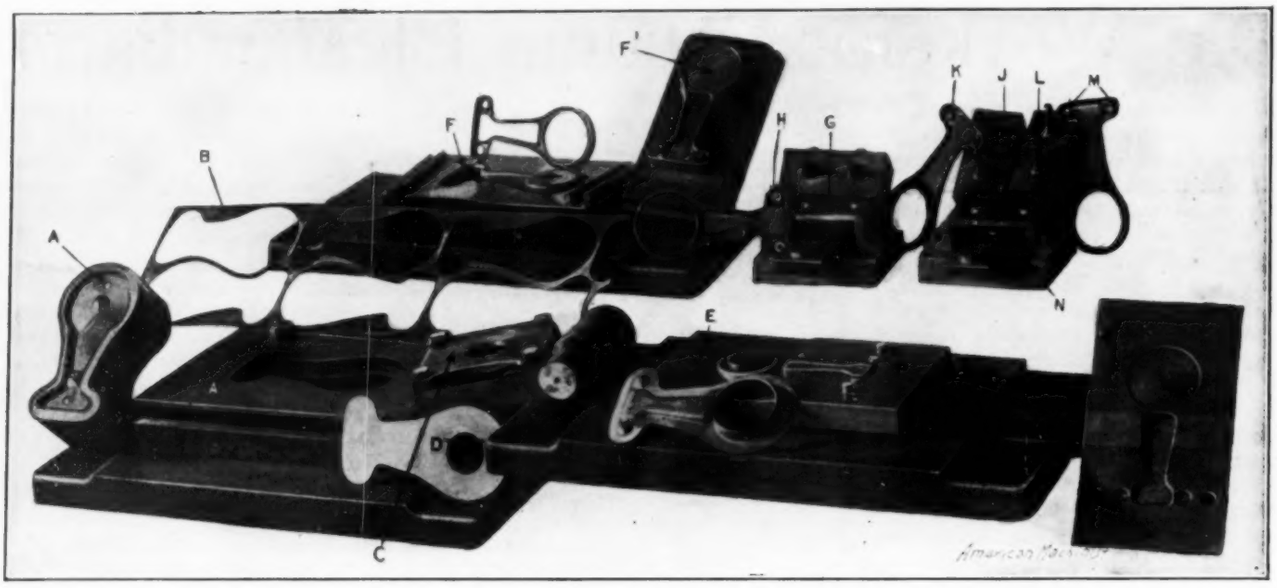

FIG. 2. PUNCHES AND DIES FOR CONNECTING ROD

and a pilot on this center locates the washer in the center of the die. At *R*, is a small die, with punch, for punching out a small hole in the same washer, this hole being eccentric and used for driving the roller later, during the grinding operation.

At *S* are shown the punch and die for blanking the fiber disks out of which the roller is made. A portion of the fiber stock, this first being scrap from a previous operation, is shown to the left. At *T* is an assembling die for the fiber disks, which are set down inside of the sliding nurled cylinder; the brass shell rivet put through and properly located by the punch shown. *U* and *U'* are the punch and die for forming the heads of the shell rivet to clinch the brass washers outside the fiber disks, completing the roller, except for grinding; one roller being shown at *V*.

STAMPING OUT THE CONNECTING RODS

In the construction of the vacuum cleaner under consideration, two short-stroke eccentrics are used, and the dies for making the eccentric connecting rods are shown in Fig. 2, these rods being stamped out of sheet steel. The blanking punch and die are shown at *A*, and the scrap metal at *B*. The piece coming from *A* is next put into the die *C*, where the central hole is punched out, as at *D*. Suitable guides in *C* locate the sheet for the punching of the hole. At *E*, the flat stamping *D* is crimped, and made into the form shown in front of *E*. In this punch, the plate *P* rests upon a rubber buffer, allowing it to drop down so that the punches will do their work. Two outside pins near the reference letter *P*, are the guides for the wing end of the work, while the boss at the other end locates the

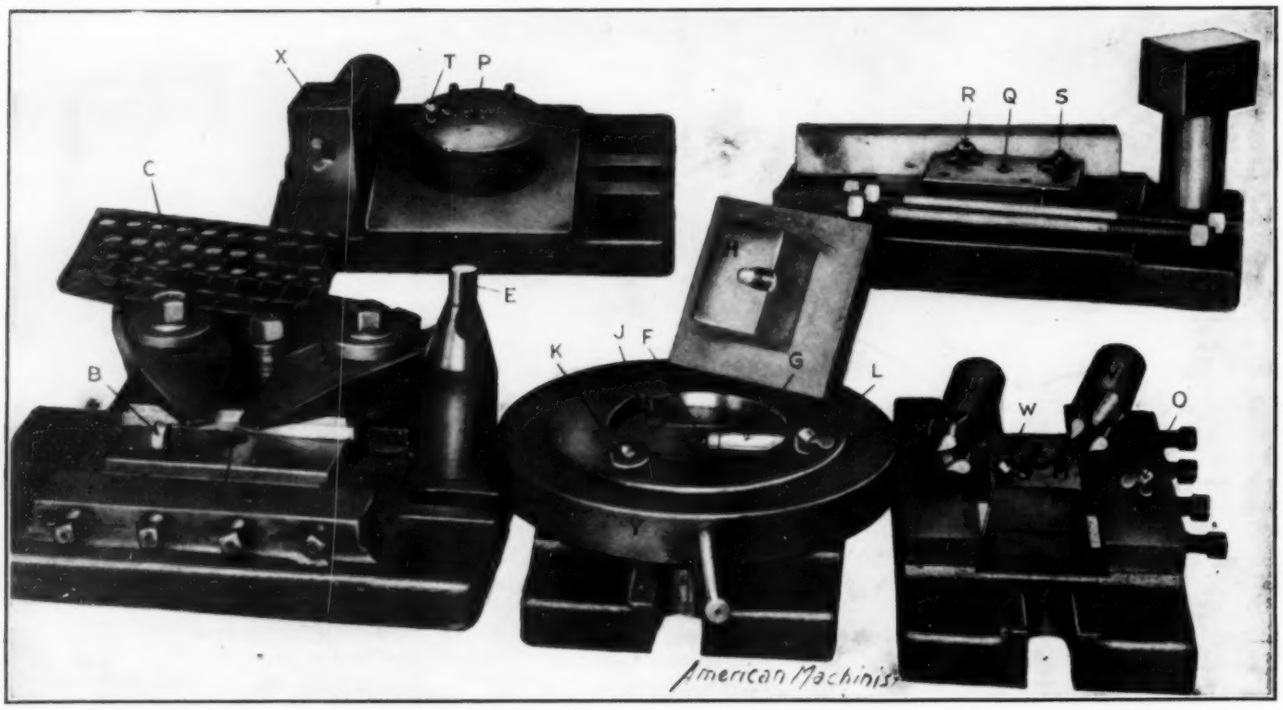

FIG. 3. PUNCHING OUT A WING NUT

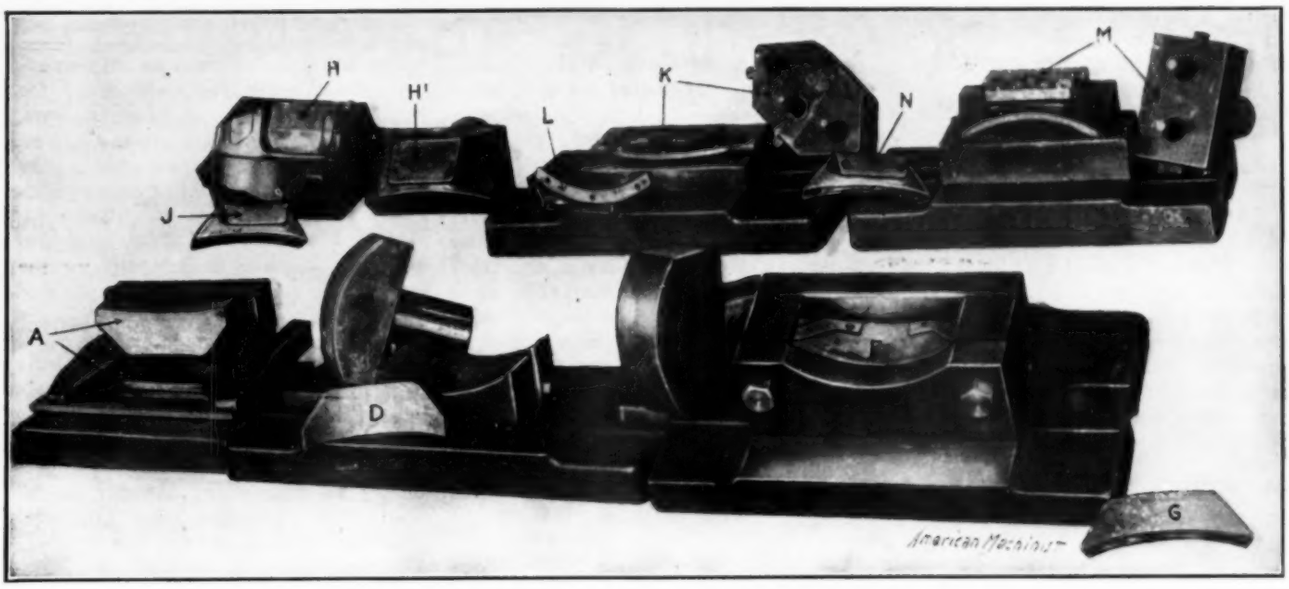

FIG. 4. PUNCHES AND DIES FOR THE PISTON BRACKET

FIG. 5. THE PISTON-VALVE PLATE RING

piece by the central hole at *D*. *E'* is the die for *E*.

At *F*, the piece is further formed, the edges being reversed, as shown. In this die the central portion drops down on a rubber buffer, while the punch *F'* forms the edges. At *G*, the holes *H* in the two wings of the connecting rod are started. Locating blocks for the work will be seen in the die *G*. Punch *J*, in connection with die *N*, further enlarges the holes, as at *K*; and punch *L* makes them the final size, as at *M*, this completing the stamping of the connecting rod.

PUNCHING, FORMING AND SWAGING A WING NUT

One of the most interesting operations, that is, the stamping and forming of a wing nut from the cold steel, is shown in Fig. 3. Blanking is performed at *A*, the piece being shown at *B*, this having been punched from ½-inch steel stock. The scrap is shown at *C*, and the punch for *A* is shown at *E*. Piece *B* is next put into die *F*, which, in connection with *H*, swages *B* out into the shape *K*. In the swaging die, *G* is a loose cylindrical punch resting in a groove in the central plate, and around this latter the ring *Y* may be rotated by means of the handle. In the position illustrated, all the parts are in place for swaging. After the operation the outer ring is swung around until the recess *J* comes behind the cylindrical punch *G*, allowing it to be freed so that the piece *K* may be removed easily from the die.

Piece *K* is next brought to *M*, where it is trimmed by the punch *U*, producing *W*. It is next necessary to give this piece a still further swaging, this again being done in *F* and *H*, producing *L*. Again, this piece needs to be trimmed in *M*, this being done by the punch *V*, which differs from punch *U* in that the clearance between *V* and *M* is less than between *U* and *M*. The result of this operation is shown at *O*, which is much fuller and neater than the piece *W*.

Rounding the corners of the wings of

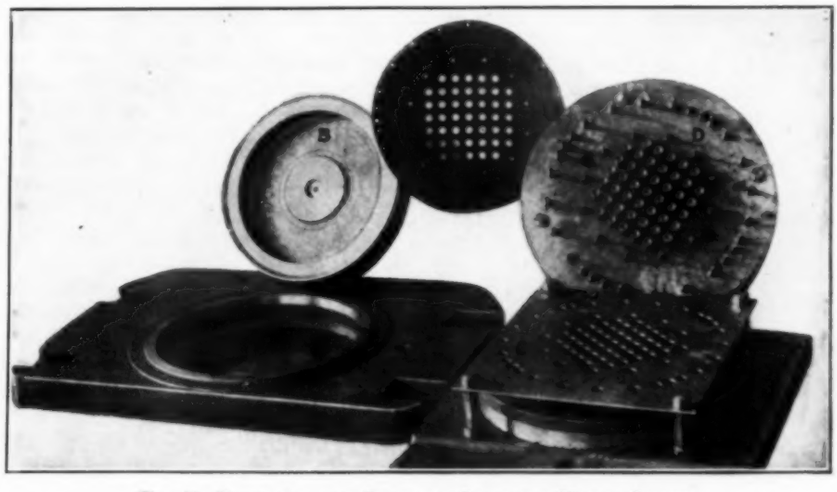

FIG. 7. PUNCHES AND DIES FOR LEATHER VALVE SHEET

the nut is done by means of the dies *X* and *P*. As seen, the conical portion of the nut fits into an open hole in each die, while the wings are swaged down smoothly around the edges, as shown at *T*. This completes the wings, but it is necessary to round up the conical body portion of the nut, and this is done in *Q*. At *Q* is a conical hole, which is the correct size and shape for the nut body. The nut is stood up with the body portion fitting down into *Q*, and the two wings down into the slots extending from *Q* in either direction, while the press head descends. This rounds up and finishes the conical portion of the wing nut, which is then a complete product, except for drilling and tapping, which next follow.

The Piston Bracket

Stamping of a bracket used in connection with the diaphragm piston, is shown in Fig. 4. Blanking is done with *A*, and the first forming operation with *C* and *C'*, producing the piece *D*. Second forming takes place in *F*, by means of *E*, producing piece *G*. Guide plates in *F* locate the work, and a rubber buffer, allowing *F* to drop down inside of the outer frame, forces the flange upward as shown at *G*. The third forming operation, that is, crimping of the cylindrical portion, is performed by *H* and *H'*, the product being shown at *J*. Correct location of the blank *G* is insured by two plate guides shown on H. At K the three holes shown at *L* are punched, and at *M* the other two holes are punched, the finished piece being *N*.

The Valve-plate Ring

Stamping and forming of the ring to carry the piston-valve plate, are shown in Fig. 5. Blanking is done at *A*, by means of the punch *B*, and at *D* the central hole is punched out, producing *C*. At *F* the first forming operation takes place, this involving flanging of the rim, forming of the cylindrical portion, and the starting of the inner roll at *R*. *H*, fitting into the ring *J*, is the punch used in connection with *F*, the central portion of the latter being supported by a rubber buffer. Punch *L* also fits into ring *J*, and is used in connection with die *M* to complete the rolling of the inner edge, as at *N* and *S*, forming a complete circular tube around the inner cylinder.

P is a formed stripper plate for punching the holes in the rim, as shown by *N*. It is necessary to thus form the plate *P*, which is mounted upon springs, in order to prevent bending of the piece *N* by the punches, there being so many holes punched at once.

A Flat Tube. Leather Valve Sheet

Rather an unusual operation is shown in Fig. 6, this being the swaging down

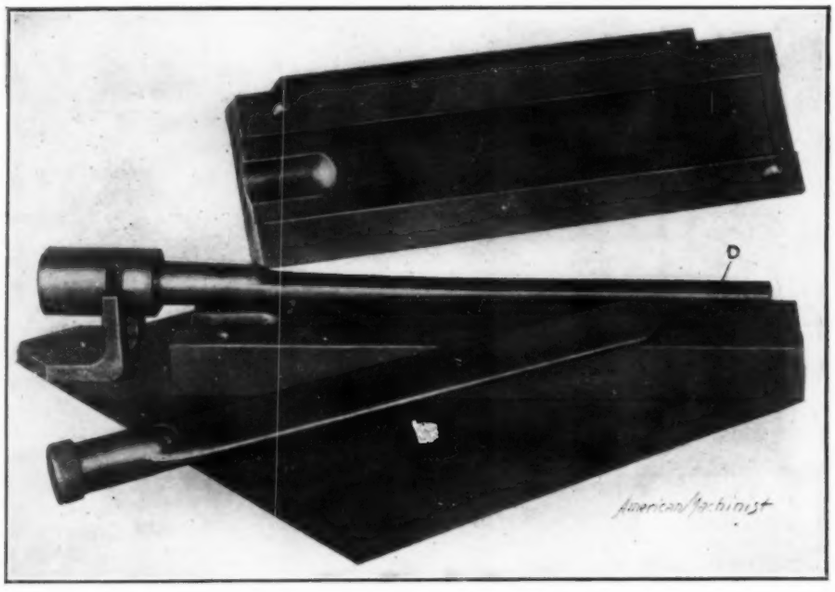

Fig. 6. Forming a Flat Tube

of a piece of steel tubing to form the piece *A*, which is part of one of the brushes for the cleaner. This is done by means of the two dies *B* and *C*, and the flat mandrel *D*. The tube is put over *D*, and then both are located between the two dies which are brought together to produce the flat tube *A*.

In this type of vacuum cleaner the air valves are composed of punched sheets of special leather working between steel plates also having punched holes, but which are staggered with reference to the holes in the leather. Punching of the leather valve sheets is shown in Fig. 7. Blanking is done by *A* and *B*, and the punching of all the holes by means of *D* and *C*. The punches in D are of soft steel with cup-shaped ends.

Trade with Argentina

The fourth of the series of talks on export trade, under the auspices of the National Association of Manufacturers, was held on Wednesday afternoon, Dec. 7, in the offices of the Association. The Hon. Charles H. Sherrill, American Minister of Argentina, was the speaker.

Instead of setting up exacting requirements, a welcome is held out for the latest goods of the producing centers of the world.

Touching upon the wealth of the country, last year $250,000,000 were paid out in dividends on invested English capital. Argentina's balance of trade last year was $97,000,000, with a population of only 7,000,000. The imports last year totaled an average of $50 per inhabitant. The business done last year amounted to the enormous sum of $700,000,000. Compare this with Brazil's total amount of business for the same period of only $400,000,000 and Mexico's similar figure of $200,000,000. The national debt today is slightly less than it was 10 years ago, and during that period the Federal revenues have increased enormously. The figure given above for the balance of trade is striking when we consider that our balance of trade for last year was only $183,000,000, and we have a population of about 92,000,000.

A decided improvement has been made in our business relations with Argentina for our exports have increased in a period of three years from $47,000,000 to $80,000,000. In the past the people of Argentina have been suspicious of the United States. Our Monroe doctrine has not been fully undestood, but the increase in our trade within the last few years is an indication that this suspicion is passing away.

Conditions at present seem to show unmistakably that trade opportunities in Argentina are more favorable now than heretofore for the upbuilding of export business.

A few things should be distinctly understood. Send down your own representative, and send a man who can talk Spanish and who can adapt himself to the conditions in a foreign country. Remember that the commission houses down there who are handling your business are not working patriotically for their American clients. They realize that lines of steamers between Europe and Argentina can bring in foreign manufactured goods in a period of fourteen days. The length of the voyage from New York to Argentina ports is from three to four weeks. That means that as long as this condition exists the order business will go to the nearer market, that is the market which is nearer in point of time. Another point, the banking facilities need improving to meet your requirements before you will be able to handle your business in the way that you should.

Strength of the Counterweight Chain

Editorial Correspondence

Examples from everyday practice used to analyze some much argued questions in machine design.

Why counterweight chain need be strong enough to carry but one weight. Clamping counterweighted head does not alter conditions.

The argument carried to through bolts.

When a part of a machine, such as the cross rail of a planer, is counterweighted by means of a cast-iron block hanging upon a chain which passes over a pulley, how strong must the chain be to support the weight? This is a question which is often raised and has caused much discussion, for some persons insist that the tension in the chain must be equal to the weight of both the cross rail and the counterweight; or twice the weight of the rail.

In order to settle this question if possible, the accompanying sketches are presented, carrying the case from a very homely illustration to the final application in practice. In Fig. 1 will be seen a man standing upon an upper floor and supporting by means of a rope a weight hanging below. It will be agreed by all, that if this weight is 100 pounds, neglecting the weight of the rope itself, the man is supporting 100 pounds and, therefore, the total pull in the rope must be 100 pounds. This is proved by the fact that a spring balance put into the rope would admittedly read 100 pounds.

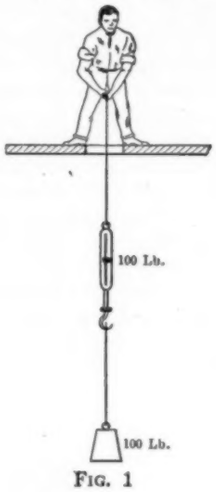

FIG. 1

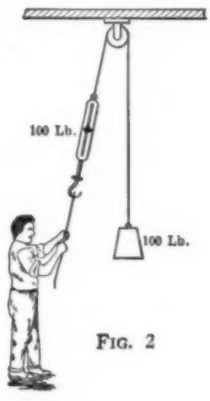

FIG. 2

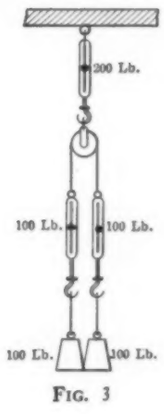

FIG. 3

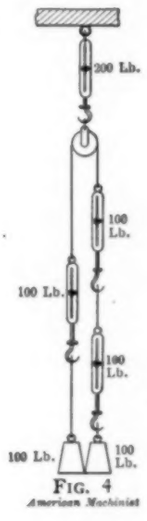

FIG. 4
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Now, glancing at Fig. 2, we see that the only change is that the man, instead of being upon the floor above, has come down to the lower floor and has attached a pulley to the upper floor beam, passing the rope over this pulley. The question now is: Is the tension in any part of the rope any different from what it was before? Obviously, the conditions are unchanged, because nothing has been done to the rope except to change its direction and, assuming no friction, the tension throughout the complete length of the rope must be the same; that is, 100 pounds, even in the part passing over the pulley. If, then, we interpose a spring balance in any part of the rope, it is clear enough that this spring balance will read 100 pounds.

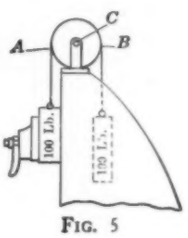

FIG. 5

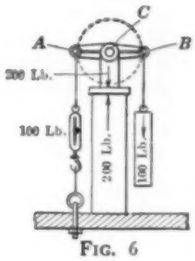

FIG. 6

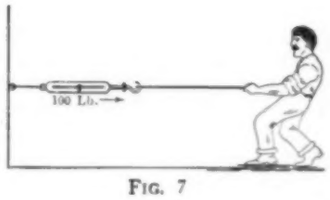

FIG. 7

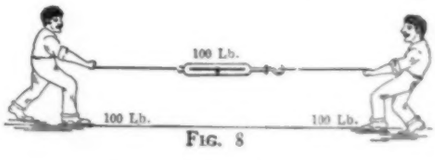

FIG. 8

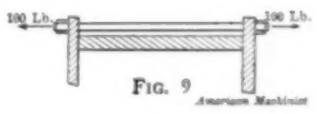

FIG. 9
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The Pulley Support

This is all right for the rope, but now how strong must the yoke be at the top to support the pulley when carrying the weight and the pull of the man? As the weight is pulling down on one side with 100 pounds, and the man is pulling down on the other side with 100 pounds, it should be obvious that the pulley is supporting a total of 200 pounds.

If this is not clear, an examination of Fig. 3 should make it so, for here we have replaced the effort of the man by a 100-pound weight. As far as the rope and pulley are concerned, the conditions in Fig. 3 are exactly the same as in Fig. 2; that is, one weight is pulling down on one side of the pulley and the new weight upon the other side, each with 100 pounds effort, and the tension in the rope, as before, is still 100 pounds at every portion of its length, just as in Fig. 2. This is shown by the two spring balances in Fig. 3.

As to the yoke carrying the pulley; it is easy to see that, as neither weight has any support except that of the rope hanging from the pulley, the yoke must support both of the weights, or 200 pounds, and a spring balance put in above the pulley, as shown, would register 200 pounds.

The Tension Uniform throughout the Rope

To overcome the objection of those persons who will insist that as one weight pulls on one side with a force of 100 pounds, and the other weight pulls on the other side with a force of 100 pounds, there must be 200-pound tension in the rope, we may glance at Fig. 4. Here we have two 100-pound weights hanging as before, but in one side of the rope we have one spring balance and in the other side we have two spring balances in tandem. It will be agreed at once that the single spring balance on the left side will be pulled down until its pointer reaches 100 pounds, just as before. Then what will each of the two spring balances on the right read? Let us consider a moment.

When there is one spring balance, the weight draws it down until the effort of the spring becomes so great as to resist the downward pull of the weight; that is, the tension in the spring is 100 pounds. First, considering only the lower spring balance at the right-hand side of Fig. 4; this will obviously be drawn down by the weight until its pointer reads 100 pounds, because it is no concern of the spring balance as to its manner of support; the

balance would act in exactly the same manner if it were hanging upon a wooden peg, as upon an iron peg, or a steel hook, or another spring. Whatever it is hanging from must resist the downward tendency by a force of 100 pounds. Therefore, the hook of the upper right-hand spring balance which supports the lower one will have an upward tendency upon the lower balance of 100 pounds. If this pull is 100 pounds, it then follows at once that the spring in the upper balance will be drawn down as long as its upper loop is held by the rope, or any other support, until the tension in its spring reaches 100 pounds also. Further than this; it is, of course, obvious that the rope itself still has a tension of 100 pounds in its fibers throughout its length, just as it did when there was only one balance in the rope, or for that matter, as it would if there were no balance at all. It also follows that the balance supporting the pulley will read 200 pounds, just as it did in Figs. 2 and 3, although, at first glance, it must be admitted, Fig. 4 gives the appearance of 200 pounds on the right being supported by 100 pounds on the left; but the reasoning given above should make it clear that the tension throughout the rope is uniform, *and equal to one of the supported weights.* A spring balance, or any number of balances put into the rope at any point would all read 100 pounds.

Application to Practice

We are now in a position to see the application of these principles to the cross rail of the planer and the counterweight, this being shown in Fig. 5. Here the cross rail is on the left and the counterweight on the right, the cross rail weighs 100 pounds and this is supported by a single counterweight. From the previous reasoning it is obvious that the tension in the chain at any point will be 100 pounds when the counterweight is also 100 pounds. From the previous reasoning also, it will be appreciated that the upward thrust of the pulley support, now taking the place of the hook shown in the other illustrations, is 200 pounds because it must support both the cross rail and the counterweight.

Another way of looking at this would be to consider weighing the whole planer. Let us say that the planer without cross rail or counterweight will weigh 2000 pounds. Now let us put on a 100-pound cross rail, clamping it to the uprights, without any counterweight. This will clearly make a total weight of 2100 pounds. Next, if we hang on the counterweight, this weighing 100 pounds, with the cross rail still clamped to the uprights, we can see that the addition of the 100-pound counterweight will increase the total weight of the planer to 2200 pounds. It is not difficult to see that if we now unclamp the planer rail, allowing it to be supported by the counterweight, the total weight of the whole machine will not be changed by this unclamping, but will remain at 2200 pounds. As the counterweight pulley must support the additional weight of both the unclamped rail and the counterweight itself, it is plain that the pulley support holds up a combined weight of 200 pounds, while the tension in the counterweight chain is only 100 pounds at every portion of its length.

When the Cross Rail Is Clamped

It may not be clear to everyone just what are the conditions in the counterweight chain and the pulley support, when the cross rail is clamped to the vertical ways. As a matter of fact, the conditions are unchanged; the tension is the same as before in all parts of the chain, and the upward force to support the pulley is 200 pounds, just as before.

This will be made clear by examination of Fig. 6. Here the left-hand portion of the chain, or rope, is attached to a loop in the floor, and the pulley at the top is replaced by the lever arm *A C B*. These letters refer to the same points on the pulley in Fig. 5, as shown. If the left-hand end *A* of the lever is held down by the tension in the left-hand portion of the chain, as it would be if the cross rail were clamped, this end *A* may be regarded as the fulcrum of the lever and the effect of the 100-pound counterweight acting upon the end *B*, will be to exert a force of 200 pounds at the point *C*. This follows because the lever arm *A B* is twice as long as the arm *A C* and the multiplication is, therefore, two. Thus, clamping the cross rail does not in any way change the forces of either the chain or the pulley support.

Other Applications

Another way of viewing the discussion above is seen in Figs. 7 and 8. In Fig. 7 we have a man pulling against a rope attached to a hook in the wall. We will assume that he can pull with a certain force which, to make it easy, we will say is 100 pounds. Now in Fig. 8 we see two men pulling against each other with the same rope between them, and we can assume that each of them is exerting the same force which the single man exerted before; namely, 100 pounds. As far as the rope is concerned the conditions are exactly the same in Fig. 8 as they were in Fig. 7. Therefore the tension in the rope in Fig. 8 is only 100 pounds, just as it was in Fig. 7, and the spring balance would so read, although in Fig. 8 each man is pulling with a force of 100 pounds.

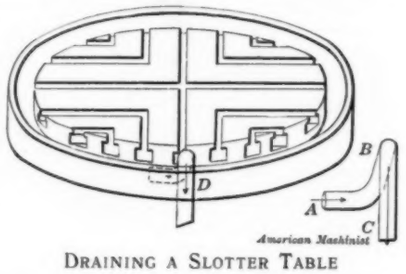
A little thought devoted to these homely illustrations should clear up a good deal of haze in the matter of design of parts of machinery, such as the counterweight chain already spoken of, or tie rods, screw bolts, etc. For it is clear that if a screw bolt has to support the head of a cylinder at each end, as shown in Fig. 9, its proportion of the load on each head being, say, 100 pounds, as before, the total pull in the fibers of the bolt is only 100 pounds, although both of the cylinder heads are exerting this pressure of 100 pounds upon the bolt heads, one against the other.

Draining a Slotter Table

The use of soda water or some other cutting lubricant or coolant is a necessity and it sometimes becomes quite a problem to prevent it becoming a nuisance on and around the machine.

The accompanying sketch shows a neat device recently found in a railroad shop in use on a slotting-machine table. This table had a deep groove around the edge and a piece of half-inch copper pipe bent up into the angles shown, kept it drained and discharged the soda water into a tank at the base of the machine. The piece has three bends as can be readily seen, the end *A* being submerged in the soda water in the groove while the portion *B* left on the edge of the table and the end *C* discharges it down into the tank by the well known principle of a siphon.

The piece is shown in position at *D* and its action can be readily understood.



Draining a Slotter Table

It can be easily made and to start it in operation it is only necessary to fill it with liquid, close both ends with the finger and thumb and keep these ends closed until it is placed in position in the groove of the table. Having no mechanism about it, it can be readily moved from place to place or from machine to machine.

Loading and Glazing

The factors that cause a wheel to "load" are hard bond and slow speed. Loading may indicate that the wheel is too hard for the work or that it is running too slow, or both. One remedy for loading is to increase the speed. If the speed is right, use a softer wheel. The factors that cause glazing are hard bond and high speed. Glazing may indicate that the wheel is too hard for the work, or it may be running at a speed too high.

A remedy for glazing is to decrease the speed. If the speed is right use a softer wheel.

Standard Bushings for Drill Jigs

By Lucian Haas*

Dimensions of various kinds of drill jig bushings which experience has proved satisfactory.

The standard types of bushings used to handle different kinds of work.

Unless a tool designer has had considerable experience in the use of bushings of various kinds, he is often at a loss to know what sized bushings to select for each case, and it is obvious that economy in the tool room demands the selection of standard bushings so that they can be made at less expense and even in advance if necessary.

The accompanying illustrations show about all the forms of bushings that experience has shown to be necessary in drilling jig work as well as the proportions which have proved satisfactory. These require little explanation, the illustrations and dimensions containing all necessary dimensions.

Fig. 1 shows the standard design of stationary jig bushings that are universally used in jig construction. The table gives dimensions.

The length of bushings should be equal to twice the diameter of the drill and small bushings should stand away from the work about 1/16 inch and the larger sizes, ¼ inch.

Slightly chamfer all stationary bushings on one end just enough to prevent shearing the hole, when they are being driven in place.

The best practice in grinding a stationary bushing is to grind the end *A* until it is a sliding fit in the hole into which it is to be pressed. The length *C* of this end varies but generally made 1/16 to ⅛ inch long. The diameter *B* of the bushing is ground straight with a allowance of 0.002 or 0.003 inch for driving.

The standard shouldered stationary jig bushing is generally used when the wall of the jig is thin and the bushing must project, it is also used to take up the thrust of a stop collar on a drill, facing tool or counterbore. The dimensions for bushings shown in Fig. 2 follow. The bushings should be ground straight and one-half to one-thousandth larger than the size of the hole, into which they are to be pressed.

Bushing for Extension Drill

Another design of stationary bushing is frequently used when a bushing is too long to allow the use of a standard drill. In this case the drill is made into what is called an extension drill. This bushing, as shown in Fig. 3, will allow the extension part of drill to enter into it.

*Chief tool designer, E. R. Thomas Motor Company. Copyrighted, by Lucian Haas, 1910.

Two Part Bushings

A stationary bushing similar to the above except that it is made up of two parts, as in Fig. 4. The body *A* is generally made of soft steel or cast iron and the hardened bushing *B*, for guiding the drill is inserted.

The design of bushing in Fig. 5, is similar to Fig. 3, except that it is used as a slip bushing and is guided by the stationary bushing *A*.

Slip Bushings

Standard slip bushings universally used in jig making for guiding a drill or reamer, are made as in Fig. 6. Dimensions of these bushings are given in the table.

The illustration in Fig. 7, is simply shown to caution the designer or toolmaker to make the head *A* of the slip bushing always slightly larger than the outside diameter *B* of the stationary bushing. The reason for doing this is to prevent the stationary bushing from being forced out of the jig in case the operator should accidentally strike the head of the slip bushing.

To prevent the bushing being forced out of the jig some designers and toolmakers slightly taper the stationary bushing, as shown in Fig. 8, but this is not often necessary and is very seldom used.

Bushings for Two Holes

It often happens that two or more

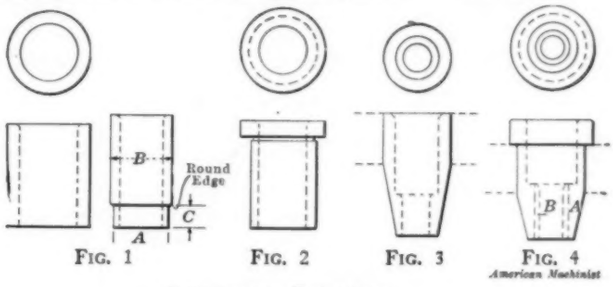


Fig. 1

Fig. 2

Fig. 3

Fig. 4

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Stationary Bushings

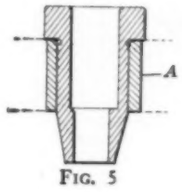

Fig. 5

Fig. 6

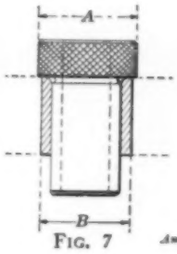

Fig. 7

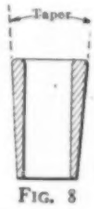

Fig. 8

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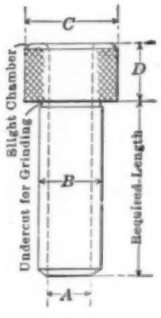
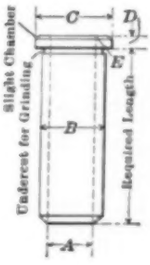
Slip Bushings





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SLIP BUSHINGS. | STATIONARY BUSH'S. | SHOULDER BUSHINGS.

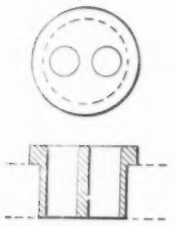

FIG. 9

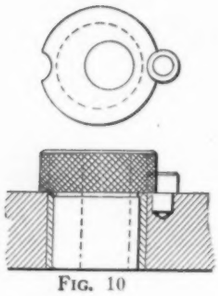

FIG. 10

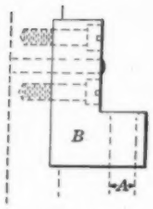

FIG. 11
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THREE SPECIAL BUSHINGS

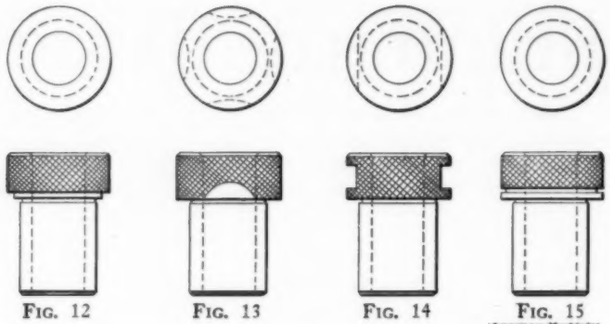

FIG. 12 FIG. 13 FIG. 14 FIG. 15
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SHOULDER BUSHINGS

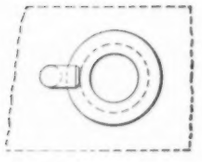
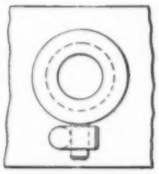


FIG. 20



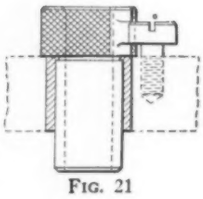
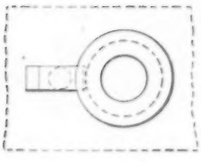


FIG. 21



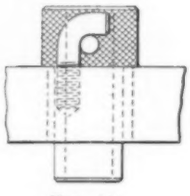


FIG. 22

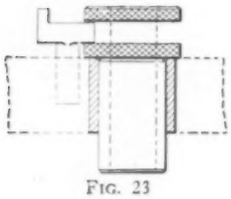


FIG. 23

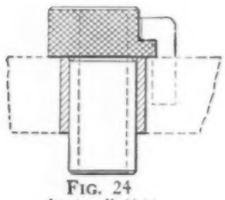


FIG. 24
American Machinist

METHODS OF HOLDING SLIP BUSHINGS

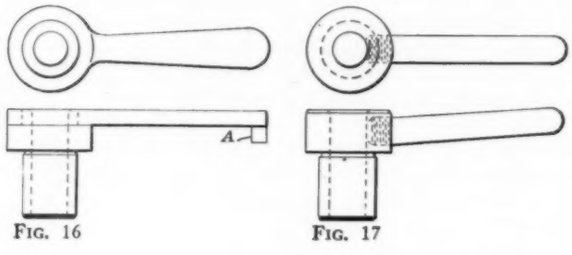


FIG. 16 FIG. 17

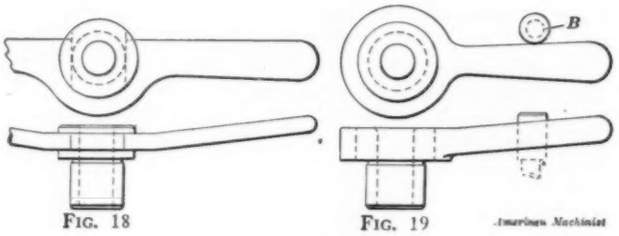


FIG. 18 FIG. 19
American Machinist

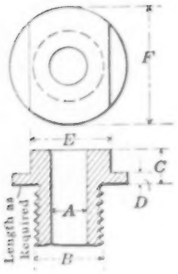
SLIP BUSHINGS WITH HANDLE

FIG. 25

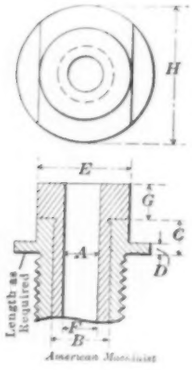
FIG. 26

FIG. 27
American Machinist

THREE SCREW BUSHINGS



STANDARD SCREW BUSHING



SCREW AND SLIP BUSHING

A	B	C	D	E	F	G	H	Thds.	A	B	C	D	E	F	G	H	Thds.
3/8"	1	3/8	1/4	1	3/8	3/8	1 1/4	12	1 1/4"	2 1/4	1/4	1/4	2	1 1/8	1/4	2 1/4	8
1/2	1 1/4	1/2	1/4	1 1/4	1/2	1/2	1 1/4	12	1 1/2	2 1/4	1/4	1/4	2 1/4	1 1/8	1/4	2 1/4	8
5/8	1 1/4	5/8	1/4	1 1/4	5/8	5/8	1 1/4	12	1 1/2	2 1/4	1/4	1/4	2 1/4	2	1/4	2 1/4	8
3/4	1 1/4	5/8	1/4	1 1/4	3/4	5/8	1 1/4	12	1 1/2	2 1/4	3/8	1/4	2 1/4	2	1/4	2 1/4	8
7/8	1 1/4	5/8	1/4	1 1/4	7/8	5/8	1 1/4	12	1 1/2	2 1/4	3/8	1/4	2 1/4	2	1/4	2 1/4	8
1	1 1/4	5/8	1/4	1 1/4	1 1/8	5/8	2 1/4	8	1 1/2	3	1/4	1/4	2 1/4	2 1/8	1/4	3 1/4	8
1	1 1/4	5/8	1/4	1 1/4	1 1/8	5/8	2 1/4	8	1 1/4	3 1/4	1/4	1/4	2 1/4	3	1/4	3 1/4	8
1 1/4	2	5/8	1/4	2	1 1/8	5/8	2 1/2	8	2	3 1/4	1/4	1/4	3	2 1/8	1/4	3 1/4	8

SCREW AND SLIP BUSHING.

A	B	C	D	E	F	Thds.	A	B	C	D	E	F	Thds.
3/8	3/4	3/8	1/4	7/8	5/8	12	1 1/4	1 7/8	1/4	1/4	1 1/8	2 1/8	8
1/2	1	1/2	1/4	1	5/8	12	1 1/2	2	1/4	1/4	1 1/4	2 1/8	8
5/8	1	5/8	1/4	1	5/8	12	1 1/4	2 1/4	1/4	1/4	2	2 1/8	8
3/4	1 1/4	5/8	1/4	1 1/4	5/8	12	1 1/2	2 1/4	1/4	1/4	2	2 1/8	8
7/8	1 1/4	5/8	1/4	1 1/4	5/8	12	1 1/2	2 1/8	1/4	1/4	2 1/4	2 1/8	8
1	1 1/4	5/8	1/4	1 1/4	5/8	12	1 1/2	2 1/8	1/4	1/4	2 1/4	2 1/8	8
1 1/4	1 1/4	5/8	1/4	1 1/4	5/8	12	1 1/2	2 1/4	1/4	1/4	2 1/4	2 1/8	8
1 1/4	1 1/4	5/8	1/4	1 1/4	1 1/8	8	2	2 1/8	1/4	1/4	2 1/2	3 1/4	8

STANDARD SCREW BUSHING.

holes are so close together that it is impossible to have independent bushings for each hole and these are then placed in one bushing, as shown in Fig. 9, or one hole is put in an extension bushing, as shown in Fig. 10. This bushing is then reversed for drilling the second hole.

Bracket Bushings

It is also found in many cases that a round bushing cannot be used at all and in such instance it is good practice to make the bushing in the form of a bracket, as shown in Fig. 11. The hole *A* guides the drill or reamer and the body *B* is screwed on the wall of the jig and dowel pinned when in place.

Removing Slip Bushings

It is always necessary to provide means for removing slip bushings. In the illustrations above are shown a few schemes which work out well, Figs. 12 and 13 being generally used. This method permits the use of a screwdriver for removing the bushings and only applies to small sizes.

For the larger sizes handles can be attached to the head of the bushing as shown. In the best designs a pin *B* can be placed in the jig, as shown in Fig. 19, or a handle *A* can be bent, as shown in Fig. 16, to prevent the bushing from turning.

To Prevent Bushings from Turning

Another important feature which is too often overlooked is means for preventing bushings (especially small sizes) from turning or coming out. A few of these methods are shown below, Figs. 20 and 23 permit the bushing to turn but hold it in place, while Figs. 21, 22 and 24 hold it in place and also prevent the bushing from turning. Fig. 22 is the most commonly used.

Screw Bushings

Fig. 25 is a standard screw bushing which is used as a guide for a drill and also acts as a means to hold or help hold the work while being drilled, or it may also act as a guide by being cupped, as shown in Fig. 26. The table gives dimensions of this style of bushing.

The illustration shown in Figs. 27 and 30 is the standard form of screw bushing containing a slip bushing. Fig. 27 shows the general practice when designing or making a bushing which is to simply act as a means for holding the work, and Fig. 30 when it is desired to hold and also guide the work by means of the cupped end. The dimensions are given underneath the cuts.

Very Accurate Bushings

If extreme accuracy is desired the bushings should be constructed as shown in Figs. 28 and 29. Fig. 28 is the style more commonly used. In either case the thread should be an easy fit to allow the pilot of bushing *A* to have a sliding fit.

In this construction it is well to have a hardened and ground stationary bushing for them to work in, so that in case of wear they can be removed. This is good practice for all styles of screw bushings.

For operating the screw bushings, it is customary to use a monkey wrench, although special wrenches can be made up as shown. These are used in conjunction with the screw bushings shown. Figs. 31 and 32 is the style head most commonly seen.

Treatment of Machine and Cold-Drawn Steel for Bushings

Upon the completion of the bushings by the lathe hand they are sent to the case-hardening department to be carbonized.

After they are carefully packed in bone in cast-iron pots, which are sealed with fire clay, they are then placed in the furnace, which is kept between 1600 and 1700 degrees Fahrenheit, and left in from 4½ to 5 hours. The carbon will then have penetrated about 1/32 inch.

The pots are then taken out of the furnace and allowed to cool off, after cooling they are unpacked and the bushings again placed in the furnace, heated to 1550 degrees Fahrenheit and quenched in a solution of salt and water.

Treatment of Tool Steel for Bushings

Tool-steel bushings are heated in a lead bath to 1550 degrees Fahrenheit, then quenched in water and cooled off in oil; after tempering they are drawn to 440 degrees Fahrenheit. This applies especially to Jessops and Saranac tool steels, but similar treatment can be used for other brands.

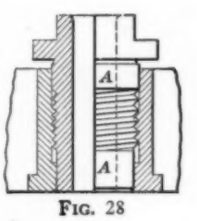


Fig. 28

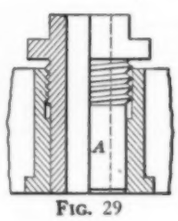


Fig. 29

Three Special Bushings

Fig. 30

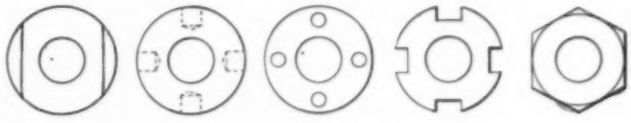


Fig. 31 Fig. 32 Fig. 33 Fig. 34 Fig. 35

Five Types of Screw Bushings

Handling Tools Properly

We are becoming thoroughly aroused to the necessity and to the advantage of industrial education, both as a means of attracting recruits to the ranks and of providing more capable workmen.

We are gradually learning what to teach and what to neglect, sometimes to the dismay of the pedagogic expert, but not the less commendable on that account. But, as is very natural, we have given most of our attention to what may be called by the homely phrase of "book learning," although we have robbed it of many of its nightmares and make it almost interesting at times.

We have overlooked in many cases, opportunities for education in actual shop matters; education that can be carried on day after day, and need not necessarily interfere with the output to an appreciable extent. Nor are the candidates for possible education confined to the boys who are just learning how to work.

The monkey wrench is probably the most common tool in the shop and yet its proper use is evidently not understood by half of the men who use it. Every broken back wrench, with spreading jaws and battered head, is mute evidence that the user had not been trained in its use. No trained mechanic would think of using a wrench backward any more than a musician would intentionally strike a discord.

While many machines are operated with apparent success by men who are almost entirely innocent of any mechanical knowledge or interest, there can be little doubt that an understanding of the principles on which they work would many times prevent breakdowns at most inopportune times, and tend to lower the total cost of production.

In our attempts to only look at the larger problems of manufacture, we are too apt to overlook some of the small expenses of operation which, if cut out, would effect a net saving.

And a little persistent instruction about the tools they are handling, either by the foreman or a good workman, will pay in increased output and reduced repairs.

Horizontal and Vertical Miller

Special Correspondence

A combination horizontal and vertical milling machine of French design and manufacture, incorporating several interesting features.

The accompanying illustrations show a combination horizontal and vertical milling machine made by the Société Francaise de Machines 'Outils, Saint Ouen, France. In these illustrations Fig. 1 shows the completed machine, which will be seen to have a constant-speed single-pulley drive, a geared feed box, geared spindle drive and combined overhanging arm and vertical spindle head. Fig. 2 shows two positions of the overhanging arm, the upper arranged to form a support for the arbor in horizontal milling, the lower arranged for vertical milling. The change consists in swiveling the combined overhanging arm and vertical spindle head. It will be noticed that the flange on this arm at the point where it bolts against the machine pillar is graduated, thus providing for setting the head at any desired angle. The vertical spindle is operative at any angle, thus being universal in character.

Referring to Fig. 1 it is seen that two straps are provided to act as supports between the knee and the overhanging arm.

Fig. 3 shows the operating handwheels and levers for both the spindle speeds and the feeds, likewise the starting and stopping handle of the machine. The spindle has eight different speeds in geometrical progression, obtained directly from the constant-speed pulley by means of gears as shown at the right in Fig. 4. These eight speeds are increased to 16 by shifting the lever shown to *A* or *B*, as the case may be.

There are 16 feeds, obtained by moving the handwheel and two levers, as shown in the lower part of Fig. 3. On the top of the box is a brass plate indicating the different speeds corresponding to the positions of the handwheel and levers. All of these feeds are independent of the spindle speeds, as the drive for the feed box is taken directly from the constant-speed pulley. Thus any one of the 16 different speeds can be used in connection with each of the spindle feeds. Throwing out the clutch from the driving pulley

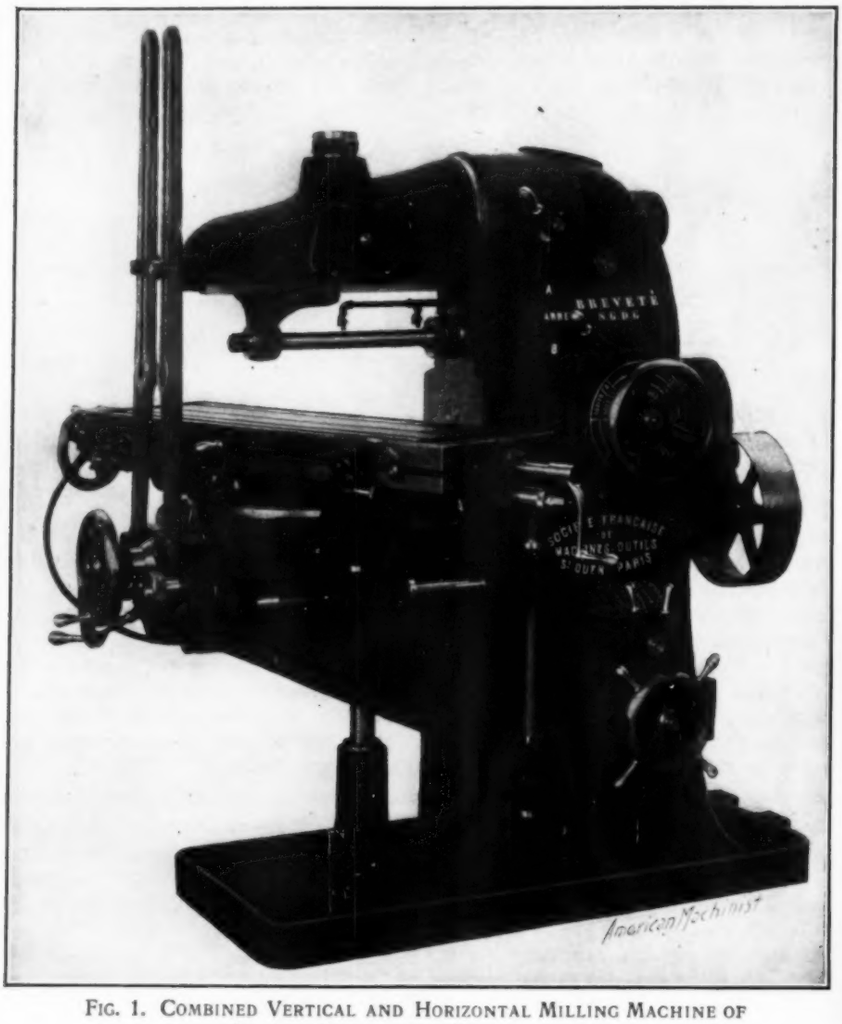


FIG. 1. COMBINED VERTICAL AND HORIZONTAL MILLING MACHINE OF FRENCH DESIGN AND MANUFACTURE

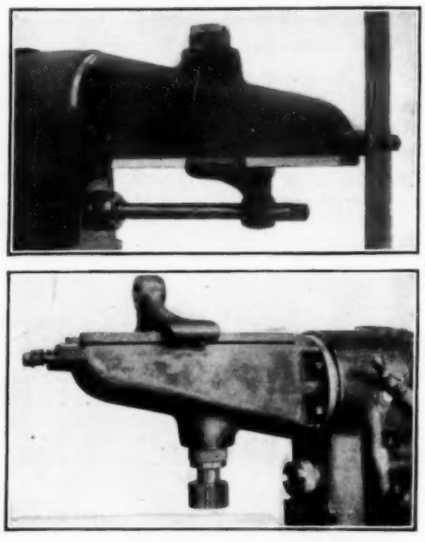


FIG. 2. TWO POSITIONS OF THE COMBINED OVERHANGING AND VERTICAL SPINDLE HEAD

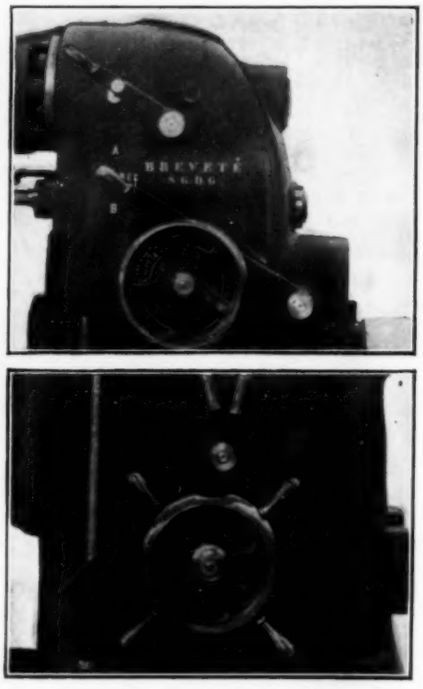


FIG. 3. OPERATING HANDWHEELS AND LEVERS FOR SPEEDS AND FEEDS

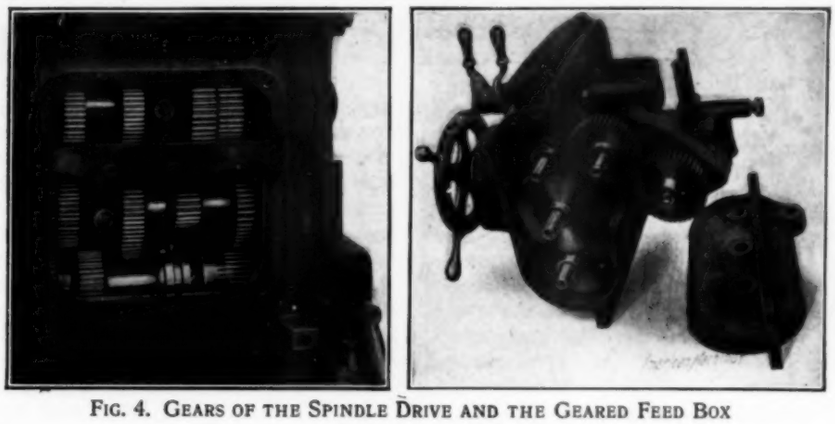


FIG. 4. GEARS OF THE SPINDLE DRIVE AND THE GEARED FEED BOX

uncouples the feed mechanism as well as the spindle-driving mechanism.

It will be noted that the feeds for the table are taken from fixed shafts and not by means of telescoping rods and universal joints.

In the base of the machine two reservoirs are provided, the one for lubricating oil for the machine itself, the other for lubricant to be supplied to the work. A double pump insures a constant circulation of both lubricating fluids.

These machines are made in four models, numbers 1, 2, 3 and 4, and both plain and universal.

It is sometimes necessary to have a spring which will stand high temperatures. Mica can be arranged as a flat spring with as many leaves as desired to obtain the stiffness necessary. These will stand very high temperatures without losing their strength. How long they will last is, of course, problematical, depending as it does on the quality of the mica.

Rivet Tests Used in Foreign Countries

The tests specified by leading foreign corporation are always of interest in comparison with cur own and are given below. The figures are given by the Rivet Bolt and Nut Company, Ltd., Glasgow.

STEEL RIVET BAR TESTS SPECIFIED BY THE FOLLOWING CORPORATIONS.

Corporation.	Tensile.	Elongation.
British Standard	For bridges and general construction work and marine boilers—26 to 30 tons per square inch.	25 per cent. on 8 diameters of breaking section.
	For shipbuilding work—25 to 30 tons per square inch.	Ditto.
British Lloyds	Same as above.	25 per cent. on 8 inches.
Board of Trade	For marine boilers—26 to 30 tons per square inch.	25 per cent. on 10 inches.
British Corporation	Same as Lloyds.	Same as Lloyds.
Germanischer Lloyds	For shipbuilding and boilermaking—34 to 45 kilos per square m/m = 22.2 to 28.75 tons per square inch.	28 per cent. on 200 m/m = 28 per cent. on 7.87 inches.
Bureau Veritas	For boilermaking—24 to 27 tons per square inch.	Minimum, 25 per cent. on 8 inches.
Indian State Railways, India Office, Crown Agents for the Colonies	For general structural work and shipbuilding—26 to 30 tons per square insh.	25 per cent. on 8 inches.
	For boilermaking—24 to 27 tons per square inch.	25 per cent. on 10 inches.

STEEL RIVET TESTS AS SPECIFIED BY THE FOLLOWING CORPORATIONS.

Corporation.	Manufactured Rivets.
British Standard	Rivet to stand bending double cold without sign of fracture. Rivet to be heated to riveting heat, and the head flattened, so that it measures in diameter equal 2.5 that of the shank, without cracks on edge.
British Lloyds	Same as above with additional tests, viz.: Rivet to be heated to red heat and bent double without fracture. Rivet to be nicked and bent over to show the quality of material.
Board of Trade	Some as British Lloyds with additional tests as follows, viz. : Rivets to be machined to a suitable diameter and tested in an approved mechanical or hydraulic testing machine, and should give the following results, viz. : Tensile—27 to 32 tons per square inch. Elongation—Not definately specified, but the average is 35 per cent. to 40 per cent. on a length equal to 2.5 diameters of turned shank. Contraction of Area—Not definitely specified, but the average is 55 per cept. to 60 per cent. at point of fracture.
British Corporation	Same as British Lloyds.
Germanischer Lloyds	A piece of the rivet shank, equal to 2 diameters long, to be cut off and staved cold to 0.6 of its original length without showing cracks or sign of fracture. A piece of the rivet shank, equal to 2 diameters long, to be cut off and staved at a red heat to 0.25 of its original length and then punched through the center without fracture.
Bureau Veritas	Rivet test same as British Standard, with additional tests as follows: Cold bend and temper bend forge tests—piece of the rivet in length equal to 2 diameters to be compressed cold to 1 diameter in length. Piece of the rivet in length equal to 2 diameters to be compressed at a red heat to 0.5 diameter long, and then punched through the center without fracture.
Indian State Railways, India Office, Crown Agents for the Colonies	Same as British Lloyds.

HEATING IRON RIVETS

For hand or machine riveting, rivets should he heated in a clean fire. The fire should have a good body of red-hot fuel, if of the ordinary foot- or hand-bellows type, and the rivets should be buried in the fuel and heated equally all over. If a furnace is used for heating, the rivets should not be put into the furnace until the temperature of the heating chamber is at a white heat.

The correct temperature for iron rivets is 2200 degrees Fahrenheit (a white heat), and the rivet should be riveted up before the heat is reduced to 1000 degrees Fahrenheit (dull-red heat).

Care should be taken not to overheat or burn the rivets, as this causes them to break in riveting or with subsequent vibration.

STEEL RIVETS

For machine riveting the most suitable temperature is 1500 degrees Fahrenheit (bright-red heat). If a lower heat is used the rivet shank may bend in the hole instead of staving and properly filling it up. Rivets staved up at this heat, with a suitable machine, rarely require calking.

For hand riveting the most suitable temperature is 2200 degrees Fahrenheit (a white heat), and the rivet should be riveted up before the heat is reduced to 700 degrees Fahrenheit (faint-red heat).

Planishing (if required) should not be commenced until the temperature of the rivet has fallen to about 300 degrees Fahrenheit, as between these two points, 300 degrees and 700 degrees, the molecular structure of the steel is undergoing such change that there is great danger of rupturing the rivet if it is hammered at this time. The planishing should not be more than is absolutely necessary to finish the point, as too much cold hammering tends to make the steel brittle.

As the result of an experiment made at Fort Monroe, in the presence of army and navy officers, it seems to be the belief that it will be recommended that the armor belt on battleships extend down to the bilge keels. The protected belt is now from 7 to 8 feet below the average water line, and the suggested increase would probably be from 15 to 20 per cent. The experiment was conducted on the monitor "Puritan" and consisted of exploding 200 pounds of nitroglycerin in the turret and hull.

Forge Shop Design and Arrangement

By Warren H. Miller

The prevailing structure is one story, without galleries, with plenty of overhead space and built of brick and steel. Forges and tools must be arranged with care, to permit of efficiency in use and ease in transporting stock and product. Design of a home-made forge.

Forge-shop buildings are almost invariably brick and steel one-story structures, without galleries and with plenty of overhead space. The distance from floor to bottom chord of trusses should not be less than 14 to 15 feet and a large monitor is essential in the roof. This may have continuous swinging sashes or alternate louvres and fixed sashes, but there must be at least six feet of sash hight. While there is no objection to wooden mill trusses, except on the score of dirt and interference with overhead light, some form of steel Fink or panel truss is better and generally cheaper. These space from 10 to 15 feet centers, with horizontal wooden or channel-iron purlins carrying a 2-inch plank roof. If slate is used some sort of Fink truss will be needed because of the pitch, and the planks must lie up and down the roof. If laid diagonally the slates will crack along the seams, due to the shrinkage of the planks, as each slate will have a nail in two planks and it cannot twist, being held by its neighbors. About 1:3 is the least pitch the roof can have. A good slate roof for forge shops is 14x24-inch slates, laid on 1-ply 30-pound roofing felt.

Forge shops of a single span, though often very long and narrow, have the advantage of feeding stock across the shop and out without interference, for that reason there are many proportions like 250x60 feet, 400x65 feet, and 550x75 feet, with a single track running up and down the shop and many cross lines feeding and taking away for various operations. But for large shops the preferred form would be that of a large central bay, say, 350x75 feet and two side bays 350x40 feet. The center bay then projects above the others, giving clear story light for the wings, besides having its own monitor for light and ventilation. It will also have a light electric traveling crane of 10 to 15 tons, while jib cranes are hung alongside the columns so as to swing work out from under the wings into the central bay. In large shops like these, 22 feet is about the usual hight to bottom chord of truss in the wings and 38 feet in the main bay. The accompanying table gives dimensions and forges of various shops:

The window area should be not less than 75 per cent. of the area of the side walls. The footing should be courses well spread to provide against the heavy vibration of the soil under the blows of the hammers. Plain brick walls and pilasters with bearing plates for the trusses will do very well for small shops with 60-foot span trusses, and steel columns with curtain walls for the larger shops having 22 feet of hight under the trusses.

Shop Floors

The floor of the forge shop is always a "made" floor of mixed cinders and sand, never brick or concrete. The latter will not stand the heat of large piles of red-hot stock just out of bulldozer or hammer, nor the rough handling and dropping of heavy bars and shapes, nor the upsetting of hot stock by ramming it down upon the floor. But cinder and sand cake with the iron scale from heats to form a hard impervious floor, not in the least permanently injured by any amount of hot iron, scalding water or rough handling of billets. It is best not to start it until all the drains, down-draft piping, steam-hammer foundations and oven foundations are in, as the excavations for these are never back-filled. This soil can then be leveled

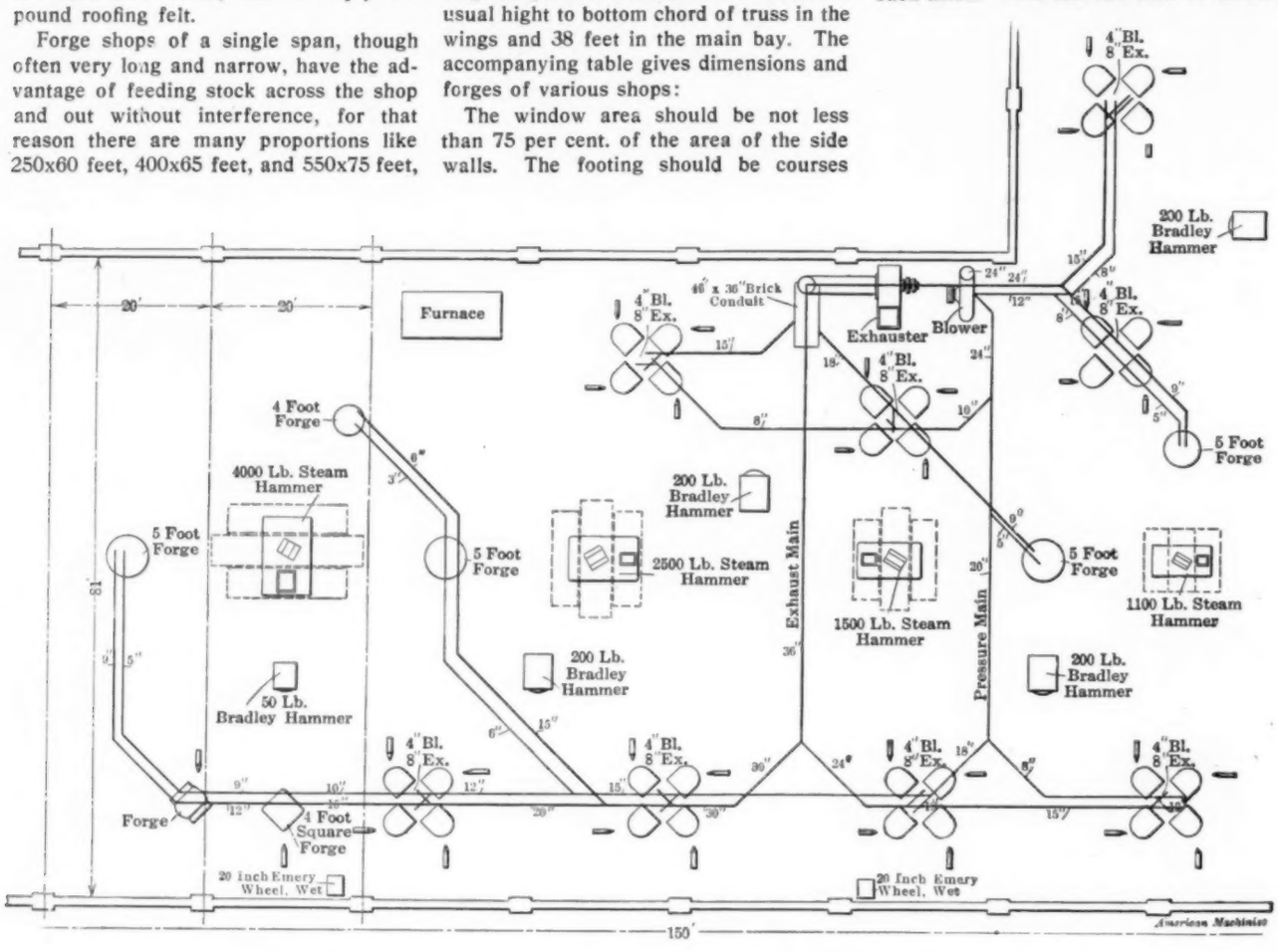


FIG. 1. FORGE-SHOP LAYOUT L. S. & M. S. RAILWAY SHOPS AT CLEVELAND, O.

off and a layer of sand be put on up to floor level. Then 5 inches of cinders are spread on and leveled and the floor is wet down with a hose daily for a month before the smiths start work.

The forge shop should be well provided with tile drains, one between each two hammers handy to the slack-tubs so as to catch water poured on work and hammer dies; one or two in the hand-forge section, and one to every two bulldozers and upsetters. They should have cast-iron catch-basins, with rose plates and a bell inverted over short risers in the basin to prevent cinders and scale being washed down the drains and choking them up.

The shop will have to be heated in winter, as there is little heat to spare if forge fires and ovens are managed properly. A 3000-foot heater coil with blast fan and overhead distribution system is ample for a shop 250x60x24 feet mean hight—considerably less than is required for an ordinary shop of the same dimensions.

For electric lighting the older plans used to provide six-ampere arc lamps on 40-foot centers, but the blue light gives too sharp shadows for forge-shop work and is hard to judge heats by. A better plan is to use street clusters with four 50-candle power metallic filament lamps inside a protecting globe. These hung 12 feet above the floor on 30-foot centers give a very strong, yellow, diffused light. Each tool having dies to be set should have an incandescent drop of its own, and these should have generous lengths of armored flexible cord and wire lamp-guards.

Stock Handling

The movement of stock determines the layout of the shop. In general the large heavy tools handling great quantities of heavy stock should be set off with their own ovens and cranes so that this stock will feed in and finished work go out without crossing any other work. Next come the large axle hammers with their attendant ovens and forges, car-truck bulldozers, etc.; then drop-forging hammers with their mufflers, and then the steam hammers for lighter work served by large five-foot forges. After them the light piece-work forge section with 250-pound and 150-pound power hammers, light upsetters, etc.; and finally the machine-shop section of the forge shop, which usually comprises a few upright drills, sensitive drills, some emery grinders, a tempering forge, etc.

The track for all this must be arranged to get the stock to the right-bar shears, thence to the forges or ovens, and take away the finished work with the least possible interference and cross-traveling. Forge-shop work always goes through in quantities on shop orders, so that each tool will have two piles around it, one for raw stock and the other for forged work. These piles are unavoidable, since it takes time to heat the work and time to forge it. Therefore, one must be on guard not to get forge-shop tools too crowded. It may look on paper as if there were plenty of room to work around the tool, but if you plant the necessary piles of stock about the tools in their proper places you will then realize just how much room is actually needed.

At the same time it is quite as detrimental to get things spread around too generously. With steel and iron at welding heat every second of time counts, so that the smith should not have to run any great distance with a hot weld to get it into a hammer.

Grouping of Tools

For small 600- and 900-pound hammers served by forges, 11 feet from the edge of the forge to the anvil is considered about right. For large hammers fed by oil furnaces, 16 feet from the mouth of the furnace to the hammer die is far enough, while large single-frame hammers handling locomotive frames require 32 feet clear swing around the anvil. From the center of a bulldozer to the muffler door is about 13 feet to allow proper handling and piling of 6-foot stock, while the oil furnaces for an upsetter handling 2-inch stock stand on either side of it, 8 feet from its center-line and 2 feet in front of it. The small steam and power hammers stand about 9 feet from the nearest forges, facing them so as to be right at the smith's hand if he wants to take a piece of work off the anvil and shove it under the power hammer. The same considerations apply to small bar and flat shears. They are mostly used to trim and cut work, and will save many a weary blow on the chisel or cold-set if one or two of them are handy in the forge section.

The grouping of hand forges varies with the size of the shop. For small installations of 15 forges they are run along one wall of the shop on 12-foot centers, curving out at the ends of the line and in the middle, so as to form two bays of eight forges each, including a power hammer and a shear, with the end forges serving steam hammers beyond the ends of the line. Along the wall the forges are set three feet from center of forge

Fig. 2. Arrangement of Forges, Sayre Shops, Lehigh Valley Railroad

Name.	Dimensions	Forges.	St. Ham.	P. Ham.	Furnaces.	Blower.	Exhaust.	Punch.	Shears.	Bulld'z'rs.	Upset.
North Pac.	240′x75′	40	3	1	5	....	.....	1	1	1	..
C. & N. W. Ry.	290′x80′	22	2	4	15	....	.....	2	4	2	3
Sheffield Car.	250′x60′	16	2	2	6	10″	30″x30″	2	2	1	1
P. & R. Ry.	560′x85′	62	6	2	13	2, 24″	2, 42x34	..	2	2	..
L. V. R. R.	200′x72′	32	2	1	3	21″	36″x36″	..	..	..	..
C. C. C. & St. L. Ry.	350′x150′	65	9	6	10	2, 24″	2, 42x34	2	2	4	4
C. R. R. of N. J.	300′x82′	32	5	2	5	....	.....	2	3	1	2
S. P. R. R.	122′x86′	14	3	..	4	21″	40″	..	..	..	..
L. S. & M. S.	150′x50′	39	4	5	1	24″	46″x36″	..	..	..	..

TABLE 1. DIMENSIONS AND EQUIPMENT OF SEVERAL LARGE FORGE SHOPS.

to face of wall, and the anvils are six feet from center of forge to center of anvil-post, with the anvil horn to the left of the smith. Though some place the anvils facing the wall of the shop, I prefer them with the horn pointing directly at the center of the forge on an angle of about 60 degrees to the wall of the shop. In this way long work on the anvil will swing clear of the next smith, whereas if facing the wall it will interfere, and if parallel with the wall it will stick out across the shop track.

For larger shops of 20 to 40 forges, a preferable arrangement is to set the forges back to back in pairs at an angle of 45 degrees. This will place the pairs on 16-foot centers, and 12 feet from the face of the wall to center of rows will give plenty of working room. About 20 feet will be needed between rows if there are more than two, and usually much more is taken to get space for a central track, hammers, shears, etc. For a 60-foot span of roof trusses, two rows of double forges with 36 feet between center of rows will give plenty of room for all the above equipment. The anvils in this case set across the shop with horns to the left and 6 feet from the tuyeres of the forges, measured on a diagonal of 45 degrees passing through the tuyere.

On still larger layouts, with 60 to 100 forges, the usual plan is to group the forges in fours with 5 feet from back to back. Each group will take about 16 feet square from anvil to anvil, and the forges are set diagonally with the anvils looking up and down the shop and square across it. These groups are set on 32-foot centers, with the same distance between rows. The hammers are placed in the centers of four groups of forges, large and small hammers in alternate bays; or else large work between one row and small work in the next. Of the four forges in a group, two are generally heavy 5-foot or 6-foot hammer forges, and the other two ordinary 4-foot forges, and these are arranged to bring all the large forges facing a big hammer and the small ones a power hammer and shears.

Draft

The question of the use of down draft should be decided very early in the design of the forge shop, for its piping and exhauster will have a great deal of influence in the placing of tools, particularly hammers with their extensive foundations.

It costs about $13 per forge per year for power to run the exhauster, and you can figure on about half the forges using the exhauster all the time. The down draft makes a clean, bright shop, free from coal gas, and if once put in, the men will object seriously to its being taken out again. It saves the cost of cleaning wall and monitor windows once a month, and also cleaning and whitening the entire roof and trusses once a year. This latter is no mean job, involving a hose and scrubbers with long-handled brooms and a shut-down of the shop while it is going on. Almost all the large railroad forge shops and many industrial shops have adopted the down draft. I favor and use it for both ovens and forges in shops of 12 forges and over. Smaller than this it hardly pays. The usual down-draft pressure is two ounces, and outlets for small 4-foot forges, 6 inches; heavy 5-foot forges, 8 inches, and furnaces, 10 inches. The exhauster used is the well known steel-plate exhauster, such as is used for planing mills, etc., and the down-draft piping is best of vitrified drain tile, laid underground. It comes in sizes from 3 inches up to 36 inches and standard 30-inch to 36-inch lengths, with all fittings such as Y's, T's, increasers and decreasers. The usual forge blast pressure is 4 ounces, and 5 square inches of blower outlet are allowed per forge. A 10-inch blower will thus run 15 forges. The smallest connection of tile-pipe run is 3 inches, though for the sake of mechanical strength 4 inches is usually used for forge blast risers.

All this piping should go in at the same time as the hammer, tool, and furnace foundations, and all drains, crude oil lines, water mains, etc., should be put down with them. It will leave the forge-shop floor in a highly mountainous state, but after it is all leveled off you know "where you are at" as regards the cinder and sand floor.

Forges

The principal mechanical features a forge should have are, first a good, heavy metal lip all around the top, which will allow work to be handled on it indefinitely without crumpling or letting the work down too far into the fire; and second, provision for getting at all the works underneath the forge. Any forge that does not fulfil those requirements is going to give trouble. If down draft, the hood should be preferably double, with a lip draft to catch outlying smoke. Any clever smith can poke a fire so as to get most of the smoke out into the shop, no matter what hood is used, down draft or natural draft, but any normal fire will go down the draft without any trouble provided the hood is made to suck in the smoke partly at the edges of the hood instead of all directly down the flue.

I have often constructed steel down-draft forges of the materials to be found right at hand about any large manufacturing establishment, considerably cheaper than any manufactured ones. A 4-inch channel is bent hot into a 4-foot ring with the channel lips looking in, and punched in the web and lower flange lip with ¾-inch rivet holes. A 4-foot circular hearth plate of ⅛-inch sheet steel is then gotten out, bored with a 20-inch hole for the hearth and riveted to the bottom flange of the channel, thus forming the fire-pan of the forge. For walls a sheet of No. 14-gage black iron, 108x26 inches, is rolled up into a cylinder and riveted to a web of the channel, coming flush with the upper lip. Around the foot of it is riveted a 4-foot circular 3-inch angle, with a few holes in the foot flange to bolt into the foundation. You now have a 4-ft. circular forge with a strong, solid upper lip formed by the upper flange of the channel. A hearth 3 inches deep and 20 inches diameter is next dished and fitted into the hole in the fire pan, and a 7-inch hole is cut in the bottom of the hearth to receive the cast-iron adjustable tuyere, which can be bought in the open market.

This completes the forge, all except the down-draft hood, which is made of No. 16 sheet iron with a 15x8-inch riser, 30 inches high, and an 18-inch quadrant circular hood. This is swung by trunnion bolts through the riser and should have a scroll inside of it extending from the throat to the lip, so as to force half of the down draft to enter the lip of the hood. To attach to the fire-pan, a 12x17-inch hole is cut in the plate and the lips bent up and punched to bolt the foot of the riser to it. To get these forges out cheaply, it goes without saying that not less than a dozen should be made in a batch, so that the plates of the fire-pan can be piled in a boring mill and bored and turned in one operation, and then all drilled together for channel flange and hearth-pan holes, and also the holes in the riser lips. The plates are then sent to cut the diagonals for the riser lips, and are then ready for assembling. The same regime is followed with the hearths, channels, angles and cylinders. The sheets of the hood are also treated the same way in quantities.

Forge and Anvil Foundations

The standard hight of all forges is 28 inches from the floor, and that of anvil posts 16 inches for a 12-inch, 175-pound anvil. Forge foundations are easily made by digging a shallow annular trench a foot deep, filling with wet concrete and setting on the forges with hook-bolts in the lower flanges while the concrete is wet. The anvil posts are best of 12x12-inch oak, 3 feet 6 inches long, sunk all but 16 inches into the ground. The anvil is strapped to them by 1 7/32-inch by 5/32-inch black-iron bands, 20 inches long, crossing the waist of the anvil and screwed into the posts. All the very tall or very short smiths should be allowed to dig up their posts and set the anvils at their own particular hight, as to work on an anvil that does not agree with the reach of one's arms is a burdensome handicap.

Beeswax makes a perfect lubricant when cutting threads in copper. The wax is merely rubbed into the threads.

German Circular Milling Machines

By Dr. Ernst Valentin

A special type of milling machine developed to handle operations commonly done on the lathe.

It can frequently be observed in industry that with the introduction of new methods in production, there at first arises in trade circles a strong opposition, which often, before a great while, becomes directly reversed, being converted into inordinately high praise for the new system. After a while, however, there takes place an equalization just to both sides, so that the new method is used alongside the old in a reasonable and appropriate manner. Such phenomena showed themselves about 25 years ago, when milling machines began to crowd out planers in so great a degree that the end of the latter seemed almost in sight. Now, on the contrary, since we have found our bearings very correctly as to the advantages of both systems, millers and planers work together in peaceful competition.

Yet it cannot be denied that there is still a line of operations for the rotating many-edged milling cutter, which it is able to perform with considerable saving of time and cost compared to fixed single-edged tool. Especially has circular milling come short of receiving the attention which, in modern highly developed repetition manufacture, is doubtless its right. The cause of this is primarily to be sought in the fact that circular milling is generally performed on vertical milling machines provided for this purpose with a special rotating table. Such a combination may indeed be suitable for single operations and for light cuts, but it fails in the repetitive production of many similar pieces and where the simultaneous service of several machines is intrusted to a single workman. The well known German machine tool factory of Ludwig Loewe & Co., Act.-Ges., in Berlin, has now applied itself to the development of a special type for this purpose, which it calls a "circular milling machine."

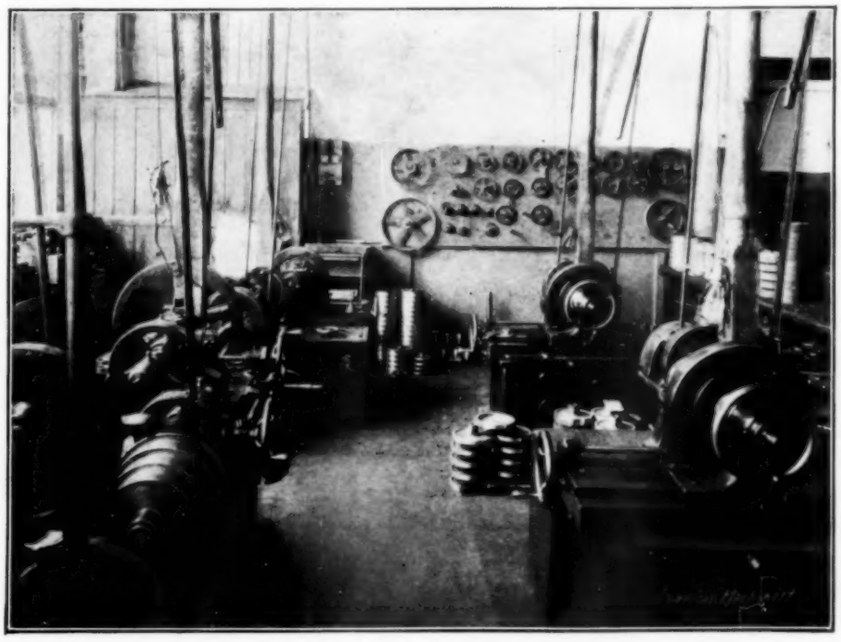


FIG. 1. A GROUP OF GERMAN CIRCULAR MILLING MACHINES

Fig. 1 shows a group of such machines. As may be noticed, the machines are placed in such proximity that a single workman can operate the four of them, the levers for this purpose being easy to reach without need of going around the machines. Over the machines are pipes brought down from the ceiling to the regions of cutting, for suction of the chips.

CONSTRUCTION OF THE MACHINE

In Fig. 2 is shown the machine in its standard form. It is driven by a belt on the cone pulley *a* upon the cutter spindle with a back gear *b* that has a speed ratio of 1 to 7. The spindle is hollow in order to draw the cutter arbor into the cone with a screw a_1, which lies in the bore. The arbor is not driven by the cone, but by two special dogs and may or may not be supported at the outer end by a bearing *c*. The support *c* is movable on the carriage *d*. The transmission of motion from the cutter spindle to the work, which slowly turned in a direction opposite to that of the cutter, is effected by a friction disk drive *e* which permits of a quick automatic change from slower to

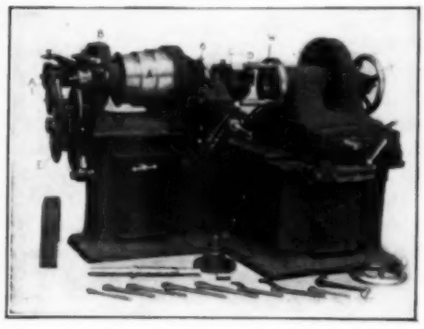


FIG. 2. TYPE OF GERMAN CIRCULAR MILLING MACHINE

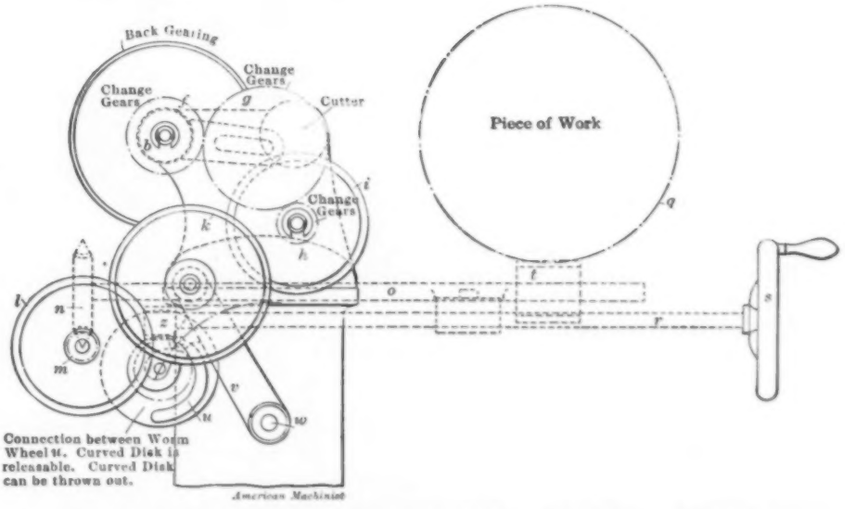


FIG. 3. DIAGRAM OF FEED MECHANISM OF CIRCULAR MILLING MACHINE

more rapid revolution of the work. The rotary speed of the work depends not only upon the material, but chiefly upon the diameter of the work itself, since the feed is proportional to this diameter.

The drive by friction wheels is clearly shown in Fig. 3. From the back-gear shaft *b*, by means of the change gears *f* and *g*, is driven the change gear *h*, on whose spindle is one of the friction disks *i*. This is in contact with the two friction disks *k*, pressing on each side of its rim and in turn driving the friction disk *l*. On the shaft of *l* is the worm *m* engaged with the worm wheel *n* on the shaft *o*. On the other end of the shaft is the worm *t* which engages with the worm wheel *q* on the shaft that drives the work is provided. A friction disk serves to drive a speed worm. On this shaft is seated another worm, whose wheel forms a nut for a spindle. The spindle rises very slowly and, at a determined point, its upper end releases a clutch coupling on the back gearing. This coupling can also be thrown off by hand by pressing a knob. When the clutch takes hold again the spindle is simultaneously turned half-way around so that by its own weight it drops again.

Some of the Work Done

In the figures, 4, 5 and 6, are shown a few kinds of work on the circular milling machine. In Fig. 4 is being milled the frame of a four-jawed chuck. the clutch cone of a lathe countershaft.

Circular milling machines are made in several special designs. One has electrical drive. The motor placed above it drives the cutter spindle by a chain. The speed of the spindle is regulated by a rheostat placed on the front of the spindle housing. In contrast to the standard construction in which only three different spindle speeds are possible, the cutter can here be regulated at pleasure from 625 to 1250 revolutions per minute.

Another design is for milling and threading projectile shells. The work spindle ends in a large three-jawed chuck manipulated by a hand wheel. Since in thread milling the work table must have, not only a rotary motion, but one parallel

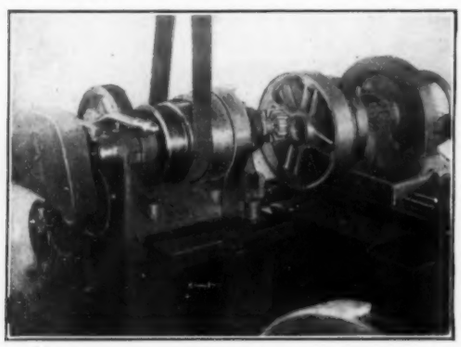


Fig. 4.

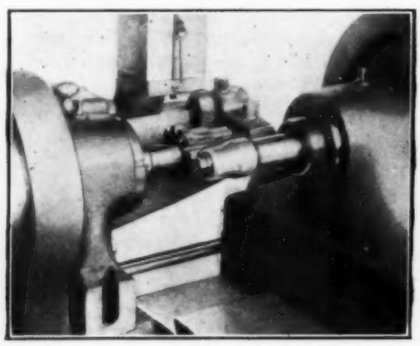


Fig. 5.

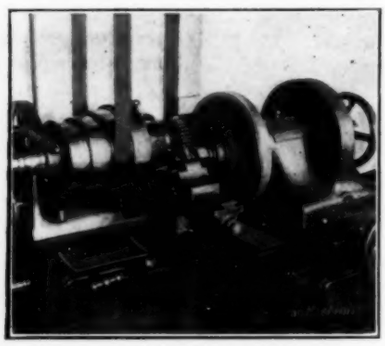


Fig. 6.

Circular Milling Machines in Use

the work. If now the work carriage be shifted by the spindle *r* with hand wheel *s*, the small grooved disk *u* is moved by the worm *z* on the spindle *r* through a worm wheel. In the spiral groove of this disk travels a pin on the link *v* which turns about the fixed center *w*, and carries the spindle of the double friction wheel *k*. If we bring, for example, the work nearer to the cutter, that is to say, if we are to cut a smaller diameter, the groove disk *u* turns toward the left, the double friction wheel *k* moves nearer to the wheel *i*, and away from the wheel *l*, so that the transmission from *i* to *l* changes from slow to quick and in consequence the work is revolved more rapidly.

The work is mounted on a spindle, Fig. 2, in a heavy carriage *x*. This carriage is adjustable in a cross direction or parallel to the cutter arbor, there being stops to set the work.

In order to facilitate a quick change of work, the spindle *w* is provided with a chucking arrangement operated by the hand wheel *y*. The work can be mounted in various ways; whether upon a face plate or on an overhanging arbor or on an arbor supported at the end. The bearing 1 is placed on a special carriage 2, which readily can be removed and which is provided with a screw 3, so as to adjust the bearing in conformity with the diameter that is to be milled.

An arrangement for automatic stopping after completion of a full revolution of

In this operation the cutter machines the circumference of the hub and a part of the ribs. In the second operation the inner circumference and remainder of the ribs are milled. Afterward the rim and other side of the frame can likewise be

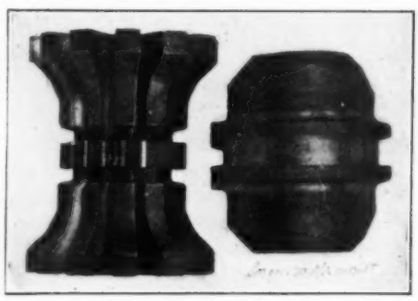


Fig. 7. Formed Milling Cutter for Circular Milling a Countershaft Spool

milled with the same cutter already in place. Both the cutter and work are mounted overhanging. In Fig. 5 is shown the machining of a friction spool. The cutter arbor is supported at the end by a bearing *c* (Fig. 2), the work on the contrary overhanging. In Fig. 6, where a gear blank is being milled, the cutter arbor is held by the support *c*, and also the work arbor in the counter bearing 1. Here, in one operation, the edge and both sides of the rim are simultaneously machined. The cutters used on the circular milling machine are standard relieved cutters, Fig. 7, showing such a one for

to the cutter spindle, at the rear end of the bed is a set of change gears driven by gears from the main shaft.

The advantage of circular milling as against turning is especially noticeable in machining comparatively large numbers of pieces. Not only can the machine be run by an unskilled workman in substitution for the highly paid lathe hand, but it completely does away with gaging the work which, in turning complicated pieces, eats up so much time and money. The machine is adjusted once for all, and then mills all the pieces with the same accuracy. Another advantage is the possibility for one workman to operate a group of machines.

A recently patented alloy called chromax bronze, consisting of chromium, copper, nickel and zinc, was tested for its qualities as a bearing metal, under which it showed very satisfactory results, according to the *Brass World*. The complete running test consisted of 363 actual running hours, after which the bearing had worn smooth and polished, and on measuring showed only a variation of 0.001 of an inch. The length of bearing was 1¼ inches, diameter of bore 1 inch, the shaft was of cold-rolled steel and the wear upon it averaged 0.0005 of an inch. The weight on the bearing was 30 pounds, that is, the valve springs weighed 30 pounds on a quarter-inch lift which while running 1750 revolutions per minute caused 7000 blows on the bearings per minute.

The Manufacture of Machine Knives

By M. E. Hoag

Evolution of machine knives from raw stock to fine edged tools.

A line of work where high-speed steel cannot be used, the chief quality of the material being ability to hold a razor edge.

The R. J. Dowd Knife Works, of Beloit, Wis., manufacture a complete line of machine knives for all purposes, such as those for wood-working machinery; for pulp mills, for paper-mills and printers' use; tinners' straight shears and metal shears; knives for tanneries, and leather-working machines; and "bed plates" for paper mills.

The materials used are Swede's iron and steel, both of which are imported direct. It should be mentioned here, that this is one line of work where high-speed steel cannot be used, for it will not hold the fine, razor-like edge required in wood working and paper cutting.

The operations in the manufacture of a typical knife are: Cutting rough stock to length; backing, or welding a soft iron back to the steel blade; trimming, slotting, rough grinding to remove scale; hardening and tempering, straightening, rough and finish grinding.

The magnetic chucks shown on the grinding machines in Figs. 1 and 2 are of interest, being made in the plant, and being unusually large and of special construction. The poles, indicated at *A*, Fig. 2, are of Swede's iron, about 1½ inches in diameter, and project about ¾ inch from the face of the chuck, which allows a free circulation of water to all parts of the pieces being ground.

In rough-grinding the chuck passes back and forth across a ring wheel 48 inches in diameter, and is fed with sand and water from the hopper shown at *B*, Fig. 1. These grindstones are held in a ring chuck, and when worn down to a thickness of 4 inches, cannot be used in these machines, but are utilized by cementing 4 together by a special process, thus making a wheel 48 inches in diameter by 16 inches face. These are used for roughing out blanks, etc., and are quite an item of economy.

The second rough grinding is done in the same manner as the first, and the finish grinding on the machine shown in Fig. 2, but with an emery wheel instead of a grindstone. This completes most of the work, though some of it is finally finished by the buffing process with emery and crocus.

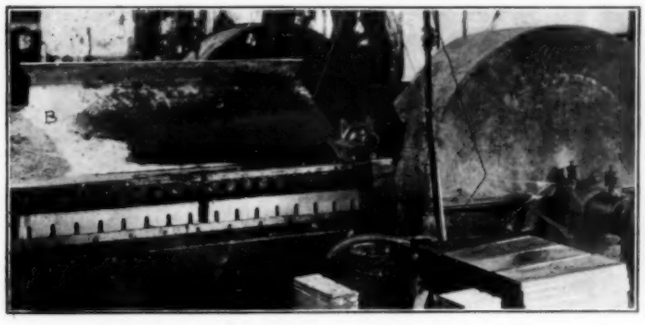


FIG. 1. ROUGH GRINDING ON SAND WHEEL

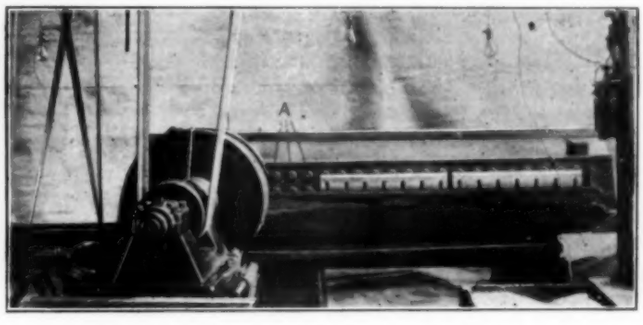


FIG. 2. FINISH GRINDING ON EMERY WHEEL. SHOWS MAGNETIC CHUCH

The Inventors Guild

In the early part of 1910, several men who had done work along the line of invention, and who, in developing and patenting their inventions, had come to realize the difficulties and disadvantages under which the inventor labors, instituted a movement for the formation of a society looking toward the betterment of these conditions. The result of this movement was the formation and incorporation in New York City of the Inventors Guild, the object of which is briefly outlined in the following quotation from the constitution of the society:

"The object of the Guild is to advance the application of the useful arts and sciences, to further the interests and secure full acknowledgment and protection for the rights of inventors, to foster social relations among those who have made notable advances in the application of the useful arts and sciences."

Some of the handicaps to which the inventor is subject, other than the proverbial one of never having any money, are the delays in the Patent Office, due to overcrowding and lack of proper facilities; the involved expense and slow-going code of litigation, and the possibility under which wealth misdirected can delay and prolong a suit, increase the expense to a point which makes such suits prohibitive for a poor inventor; conditions which have been made the subject of separate articles in our columns.

The membership of the Inventors Guild is limited to 50. The idea for limiting the membership is that with a small society of this sort it is easier to accomplish real results than with a larger organization, hampered as it must be by unwieldiness and red tape. Further, with a small organization each man will feel that he is a working unit, and that he will be depended upon to do real work, whereas in a large organization the general feeling is that there will be plenty of other men to do the work, and that lack of assistance from any particular member will make little, if any, difference. The result is that in the large organization the work, if any, is usually done by even a smaller number of members than that provided for here.

It is proposed to select the membership of the guild carefully, and to this end a member must be formally proposed by a member of the guild, must be personally known to five members of the guild, must pass the membership committee and board of governors, and finally must be voted upon by the whole membership, 4 per cent. of the votes cast being sufficient to reject a candidate. The object of such discrimination is to include among the members of the guild men who have not only evolved inventions, but who have achieved some measure of success with such inventions, and who will, therefore, be capable of exerting some influence.

The officers of the guild are as follows: Ralph D. Mershon, president; Charles W. Hunt, 1st vice-president; Charles S. Bradley, 2d vice-president; Thomas Robins, secretary, and Henry L. Doherty, treasurer. At the present time the guild has 29 members, all prominent men, among which are found Thomas A. Edison and Peter Cooper Hewitt.

Distribution of Indirect Costs

By Holden A. Evans*

The simplest method is best for the great majority of shops; remembering, that the indirect costs should be apportioned in such a way that each production order will receive charges which closely approximate to the proportional benefits it receives from the various elements of the indirect costs.

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The distribution of indirect costs should depend to a certain extent on whether payment for the work is made on the basis of cost plus a percentage of profit, or by the jobs.

In some establishments there is much work for which payment is made by taking the book costs and adding a percentage of profit previously agreed upon. This is frequently the case in large ship-repair jobs, where it is difficult to determine exactly the work necessary until everything is uncovered. It is often the case in repair jobs in a machine shop. Frequently large buildings or other large undertakings are paid for in the same manner. Under these conditions the purchaser has the right to check, day by day, the men employed on the work, and also to investigate the book charges. In such cases the indirect charges, if high, may be the cause of much contention, and this may result in the firm not getting future contracts. Very few understand indirect costs, and not a few, who have work done at cost plus percentage of profit, feel that in the indirect charges they are paying for something which they do not receive. They realize, of course, that the general expenses must be paid, but they consider that 15 to 20 per cent. of the direct-labor charge is ample to cover all legitimate expenses, and that anything in excess of this is simply additional profit. An establishment which charges 60 or 70 per cent. for indirect costs will be looked upon as guilty of extortion and not only will never get additional work from the customer so charged, but its reputation will suffer and it will lose other customers.

Scientific ideals are excellent, but, after all, a shop or factory exists to make money. This is essentially a commercial age, and the successful engineer must recognize this fact and put aside some of his scientific ideals if, by so doing, he can place the concern for which he is working in a better position to make a commercial success.

In an establishment which does much work on the cost plus a profit basis, the cost system must be arranged so that the indirect costs will not appear large. This can readily be done by charging everything possible direct to the work. In this case subforemen, leading men, etc., should be charged direct; all miscellaneous material, as oil, waste, emery cloth, etc., and also small tools should be charged direct instead of to the expense number. Machine rates should be used, and to these should be attached interest, depreciation, taxes and insurance, not only of the tool, but also of the building. By following these methods the remaining indirect charges will be small, and the percentage added for indirect costs will appear to the buyer reasonable. This also gives the buyer an opportunity each day to check that which has been charged to his account against what has actually been used.

In a strictly manufacturing establishment, or in shops where the repair work is taken at a contract price, no such conditions exist, and it is more accurate and more satisfactory to make the charges to product differently.

Distribute Indirect Costs in Accordance with Benefits Received

The distribution of the indirect costs should be made in such a way that each production order will receive charges which closely approximate to the proportional benefits it receives from the various elements of indirect costs.

It is well to recognize that any practicable scheme which has been devised or which has been proposed for distributing these costs can be adversely criticized. Any manager or engineer can take any proposed system which can be put in operation without great cost, and advance many good reasons to show that it is inaccurate. But it should be remembered that a system proposed by these same critics will be subject to the same fate at the hands of others.

As stated before, scientific accuracy cannot be obtained. Moreover, a system well suited to one establishment is not suited to another. The only wise course is for a manager himself to thoroughly study cost accounting, and then secure an expert to work out, under the general instructions of the manager, the details of the system. Few managers have the time to devise and install a system, and at the same time attend to their other duties, but they should thoroughly understand the principles, for unless they do, they will be unable to give the expert the assistance and support needed to enable him to work to the best advantage.

Distribution by Machine Rates the Most Scientific Method

In the present day, machinery performs a very important part in the production of work. Very expensive machines are designed and built to reduce labor charges, and thousands of automatic and semi-automatic machines are today doing the work that was formerly done by many thousands of highly paid mechanics. It would seem that the machine-tool time is the most accurate and most satisfactory method of distributing the indirect costs, and nearly all engineers consider this the most accurate, but some do not consider it the most satisfactory method. Some progressive engineers have little patience with those who cling to labor as a means for distributing these costs.

A great many of the indirect expenses of a factory attach themselves naturally to the machine tools, as will be seen from the analysis of this method. We have seen in previous articles the disadvantages of charging interest, depreciation, taxes and insurance to general expense and distributing this on the basis of direct labor. These troublesome items of expense naturally attach themselves to the machines. As a large part of the cost of the plant is machinery, and as a large part of the cost of real estate, buildings, etc., is for the benefit of machinery, it is natural that the expenses mentioned should be distributed on the basis of machine-tool time instead of labor time. Take first the machine itself; the interest on the money invested in the tool itself and its foundations, the depreciation, taxes and insurance due to the tool can be paid for by the work produced by the tool. The power consumed in running the tool and repairs to it should be charged to the product of the machine. It would, therefore, seem that there can be no question that at least these expenses should be based on the machine time. The land occupied by the shop, and the building itself, are as much for the benefit of the machines as for the labor employed. The expenses due to interest, depreciation, taxes, insurance and repairs of buildings and land can be apportioned to the machine time by making the distribution on the basis of floor space occupied by the machines. A number of other expenses attach themselves readily to the machines, and by going through these carefully it seems as if it might be possible to establish an accurate rate for each machine and appliance, which will leave but few expenses to be apportioned on the basis of labor. There is no doubt that this method, if it can be followed, is more accurate than distribution on the basis of labor alone. I believe that in years to come the indirect expenses will be distributed in this manner, that is, partly by machine times and partly by labor. At the present time, however, it is impracticable in many shops, and there are very few where it can be used with any degree of accuracy. In carrying out such a system it is necessary to make many assumptions, which may be correct,

but which are more likely to be very much in error, and the results are likely to be fully as inaccurate as if direct labor had been used as the basis for distribution, and the machine rate involves much more clerical work.

Difficulties in Following Machine-rate System

A few of the difficulties which will be encountered in attempting to follow this system will be given: From the scientific point of view the cost of power should be distributed to the machines that use the power. In some of the best treatises on accounting we are told that the power expense should be so distributed and the subject is then usually dismissed with a general statement to the effect that the proportion of the total power used by each machine should be measured or estimated and the power expense distributed on this basis. This is well enough for the expert accountant, but the managers and engineers well know that it is not practicable to determine the power used by the various machines under varying conditions, and that so called estimates of power used by each machine are nothing more than guesses.

If the power were entirely electric, and the machines were motor driven, after extended observations fairly accurate estimates might be made, but even under these conditions the rate for each machine will vary in accordance with the work done. In many shops there is electric, steam, compressed air and hydraulic power, and it is impossible to even approximately distribute the power expense to the machines in accordance with the actual power used. Under present conditions a manager can feel well satisfied if he can approximately determine the proportion of the total power cost that should be borne by each shop.

We are also told that the cost of heat should be kept separately and apportioned according to cubical contents, and that the cost of light should be apportioned in accordance with floor area. The manager well knows that this is impossible; the lighting circuits are, in nearly all cases, taken from the power mains, and the same boilers that supply steam for the steam hammers supply steam for the testing slab, for heating, for driving tools, and a number of other purposes.

Any attempt at scientific accuracy in the distribution of the power expense must necessarily be a failure.

If, however, assumptions are made and a machine rate carrying the greater part of the expense burden is established, other serious difficulties are experienced in applying these rates. It is seldom that any machine tool is continuously employed, and some disposition must be made of the idle time. This can be done by estimating the number of days in the year that the machine will be used and basing the rate on the probable use of the machine, or by charging the idle time of each machine to an expense number and prorating this by direct labor, or by the use of an auxiliary rate for idle time. The use of any of these methods immediately destroys any claims that may have been made for scientific accuracy.

There is still another important objection. There are very few shops in which work is carefully routed to the machine best suited for the work, and oftentimes work will go to a large machine with a high rate when it could have been done equally as well in a smaller machine with a lower rate. Or even if the work is carefully routed it will often be found that the smaller machines are crowded with work and to avoid delay the work which should go to the small machine is put in an idle large machine at a much higher rate. These conditions completely upset accurate cost keeping and give costs which are very misleading. Whenever machine rates are used in a jobbing shop these difficulties are encountered, and I know of cases where considerable delays have been experienced because a foreman who wished to keep down his costs would not put work in an idle machine of a higher rate, but would wait for days to get the work in a lower-rated machine.

The machine-rate method is, no doubt, theoretically very attractive, and it is advocated not only by accountants, but also by many engineers, but in practice this system has made no great headway, on account of the difficulty of its application to the average shop.

Inaccuracies of Distribution by Direct Labor Method

Distribution of the burden by the direct-labor method is admittedly not scientifically accurate, but is by far the most simple and is most generally used. It is, therefore, desirable to examine the inaccuracies of this method.

Many of the expenses attached to a manufacturing plant bear no relation to the direct-labor expenditures. This is particularly true of the fixed charges, such as interest, depreciation, insurance and taxes; these charges go on whether labor is employed or not, and their distribution by direct-labor expenditures cannot be defended except on account of the simplicity of the method and the knowledge that under the shop conditions usually found, any other method is equally inaccurate.

Under the direct-labor method, work done in costly automatic machines, or in semi-automatic machines with cheap attendants, receives but a small part of the indirect charges, while it should receive a large part. The work at the bench, which requires practically no equipment, but does require a skilled machinist at perhaps $4 per day, is charged with twice as much burden as the work in a ten thousand-dollar machine run by a $2 a day operator. To carry this still further, the work in the ten thousand dollar strictly automatic machine carries none of the burden, not even power, while rightfully it should carry a large proportion of the burden. On the other hand, it must be admitted that in the average shop these conditions are exceptions, and these can be met by making charges for the use of special machines and deducting the amount so charged from the shop-expense burden, distributing the remainder in accordance with the direct-labor expenditures. Any system of cost keeping must be applied intelligently to meet special conditions. This is one of the reasons why only managers and engineers are able to plan a satisfactory system. The expert accountant knows nothing of these conditions, and it is not possible for him to meet them.

Distribution of Indirect Charges by Direct Labor

There are several ways of distributing the burden in accordance with the direct-labor expenditures. The one most generally used is to determine the proportion of the indirect shop charges to the direct labor expended in that shop, which gives the rate in cents for each dollar expended on direct labor. The general expense rate is determined by dividing the total of the general expenses by the total direct labor of the establishment. These two rates are added and multiplied by the direct labor expended in the shop on each production order, which gives the indirect charges for each order for that shop. For example, in an establishment with a machine shop, a blacksmith shop and an electrical shop, the expenditures are as follows:

Machine Shop:	
Direct labor charged to production orders	$5,000
Indirect shop charges, labor, material and expenses	2,500
Blacksmith Shop:	
Direct labor charged to production orders	$1,000
Indirect shop charges, labor, material and expenses	700
Electric Shop:	
Direct labor charged to production orders	$1,000
Indirect shop charges, labor, material and expenses	400
General Expense:	
The general expenses, not chargeable to a shop, amount to	$1,400

The expense rates are then as follows:

Machine shop, $\frac{2500}{5000} = 50$ cents for each dollar of direct labor expended;

Blacksmith shop, $\frac{700}{1000} = 70$ cents;

Electric shop, $\frac{400}{1000} = 40$ cents;

General expense, $\frac{1400}{5000 + 1000 + 1000} = 20$ cents.

The direct labor charged on each production order in the machine shop is increased by 0.7; in the blacksmith shop by 0.9; in the electric shop by 0.6. The

sum of indirect charges thus obtained is the total indirect cost for the order.

A production order on which the direct-labor expenditures are: Machine shop, $200; blacksmith shop, $100; and electric shop, $50; will carry the following indirect costs:

Machine shop	$200 × 0.70 = $140
Blacksmith shop	100 × 0.90 = 90
Electric shop	50 × 0.60 = 30
Total indirect costs	$260

This can be carried in the total cost as a separate item, the elements being direct labor, direct material and indirect costs; or, if desired, the indirect charges may be merged into the labor and material by adding the labor portion of the indirect charges to direct labor and adding the portion due to material and expenses to the direct material, the total cost showing only as labor and material.

The latter method is strongly advocated by some of the best English authorities—particularly for shipyard accounts. This method has an important advantage, in that it enables the engineer to establish unit prices—per pound, per foot, per piece, etc.—separately for labor and for material. Costs divided in this manner are of assistance in the preparation of estimates for new work, particularly if the work is a large undertaking such as the construction of a large ship.

Another method for the distribution of the indirect charges is by means of the direct-labor hours. In accordance with this method the shop-expense rate is determined by dividing the total shop expense by the number of hours of direct labor expended in the shop. The general expense rate is found by dividing the total general expense charges by the total number of hours of direct labor expended in the establishment. These rates are applied as described and illustrated above, except that the hour of direct labor is the unit of distribution instead of the dollar of direct-labor expenditure.

There are arguments both for and against each of these two methods. The distribution by expenditures for direct labor is more simple and does not require as much clerical work as the hours of labor method, and it is probably for this reason that it is more generally used. The hours of direct-labor method is a little nearer to the machine-rate method which will no doubt eventually be used when scientific shop methods become more general.

Shall the Actual Monthly Rates, or the Average Rates Be Used?

In the distribution of the indirect charges, rates determined by previous experience, as the last year's rates, are somtimes used instead of the actual rates determined each month. For the purpose of cost keeping there can be no objection to using the actual rates determined each month, and this method has many advantages. In the preparation of estimates for new work, however, the average rates should be used or, better still, the average rates corrected for conditions that are expected when the work will be undertaken. In this way any abnormal conditions affecting the monthly rates will not show in the estimates. By using the actual monthly rates for cost keeping the entire expense is distributed and there is no necessity for a loss and gain expense account.

Simplest Method Best for the Great Majority of Shops

The importance of better cost-keeping methods in removing demoralizing competition and establishing stable conditions in much of the repair and manufacture work, has been previously pointed out. The establishments that it is desired to reach are not the ones where the manager is debating whether he shall distribute the charges for heat in accordance with floor area occupied by a machine or the cubical contents taken up by the machine. The establishments that I desire to reach are the thousands where the manager does not include in the costs charges for depreciation or interest, and if these are considered at all it is only to take out of the profits at the end of the year a lump sum for these and other fixed charges, and the amount depends on the amount of the profits. If these thousands of establishments can be reached and managers and owners can be interested in better cost methods, a great deal of good will be accomplished.

It is, therefore, desirable to present a skeleton cost system in the simplest form. The most simple methods which require the least amount of clerical labor are, therefore, chosen and the distribution of the indirect costs is made by means of the direct-labor expenditures.

With interest awakened in the subject of cost accounting many managers will study the question as applied to their own conditions, and each can go as far as he likes or as far as his conditions will warrant in his effort to secure greater accuracy. If a manager prefers he can use the productive-hour rates to distribute the indirect charges with practically no changes in the methods outlined. Or, if he has some expensive automatic or semi-automatic machine tools, for which he wishes to charge rates, he can establish the rates and charge these to the production orders and subtract the amounts thus charged from the shop expense.

Perhaps in some shops where cost methods have received but little attention in the past, machine rates can be successfully established, but it is recommended that before the machine-rate system is started a good shop organizer be secured to work out all details.

The Work in Each Shop or Department Should Carry Its Own Expense

The expenditures made for the benefit of the work in a shop or department should be distributed to the work accomplished in that department. Each shop or department should, therefore, have a separate expense account, which is subdivided into a sufficient number of subaccounts to enable a manager to know exactly for what each expenditure is made. It is only in this way that extravagance can be checked, and the benefits derived from each expenditure determined. A common method of but one expense account for each shop against which all expense for the shop is charged is very unsatisfactory and leads to extravagance, and it is impossible to analyze the expenditures. Not only should the shop expense carry the usual expenditures made to this account, but it should carry its proper share of the fixed charges. Interest and rent based on the investment in land, buildings and equipment should be included; depreciation of buildings and equipment should be included; taxes to shop land, buildings and equipment should be included; insurance of shop buildings and equipment should also be included.

The amount of these fixed charges that should be carried by the shop expense is easily determined; for interest, taxes and insurance it is only necessary to determine the amount of the shop investment or value as a proportion of the total investment or value, and use this proportion applied to the total charges under each head for the entire plant; for depreciation the actual amounts to be written off due to the shop buildings and equipment should be used. The proper proportion of the total power-house expense should be included in the shop-expense account, but this is not so easily determined. When so many are advocating the distribution of this expense to each machine we can at least claim that a fair approximation can be obtained for each shop. If electric power only is used the power consumed by each shop can be obtained exactly from meter readings. This, however, is seldom the case, as ordinarily steam, compressed air, hydraulic and electric power are used, and the situation is further complicated by the fact that in many establishments power is used outside of the shop by men from the shop; for example, compressed air by the machinists for running air tools, or electric power for the same purpose or for electric lights, or both forms of power for hoists for handling material in erection work. These same conditions exist for nearly every shop in the establishment. Under these conditions it is impossible to measure the amount of power used by each shop and the men from the shop. The

proportion of the power-house expense to be borne by each shop or department must, therefore, be estimated.

In making this estimate consideration should be given to the following conditions in each shop: number of machines requiring power and total horsepower required; proportion of time machines are in operation; the amount of power required by men working outside of the shop; the quantity of work in each shop. From consideration of these conditions the manager determines the proportion of the total power expense that should be borne by each shop. This proportion may vary from month to month owing to change in conditions, and the percentage to be charged to each shop should be determined each month. No doubt some will consider that due to the inaccuracy of estimates obtained in this manner that the power expense might as well be charged to the general expense account and prorated direct with that account and thus reduce the clerical work. This view is not well taken, for we know that some shops, for example, the paint shop, employ a comparatively large number of men and use but little power, while the forging shop, employing a less number of men, uses a very large amount of power. By charging power to the general expense each dollar expended in the paint shop for direct labor carries as much burden for power as each dollar in the forging shop. By distribution to shops, even though based on estimates, these glaring inequalities can be avoided.

Power-plant Expense

The power-plant expense should be recorded under appropriate subheads as described for the shop expense. There should be included in this not only the expenditures for repairs and maintenance of buildings and equipment, and labor and material employed in the production and transmission of power, but there should also be included charges for depreciation, interest, taxes and insurance due to power-house buildings, land, machinery and transmission lines. The upkeep of transmission lines from the power house to the shops should be charged to the power-plant expense. Transmission lines and power machinery inside of the shops should be charged to the shop expense. This is a more or less arbitrary division, but it is reasonable and works well in practice. The power expense for each month is apportioned to the various shops or departments in the manner previously described.

Storehouse Expense

The storehouse should be conducted as a separate department and should have an expense account properly subdivided. The total expense of the storehouse and purchasing department should be distributed to material issued for production orders and this expense disappears, becoming an element of the cost of the material.

The storehouse expense must include interest, taxes and insurance on storehouse land, buildings, equipment and stock. Depreciation of buildings and equipment must be charged and in a separate account depreciation of stock, and losses due to breakage and waste must be charged. The storehouse expense should be distributed each month to the issues for that month. Generally this should be applied as a percentage of value, but in the case of articles like lumber, structural steel, etc., received in large quantities, and where the expenditures for receiving, transporting and piling are large, separate orders should be issued for this work, and the cost should be charged direct to the cost of the material.

General Expense

The general expense includes the cost of administration, office expenses, fixed charges, etc., that cannot be located to shops and departments, and the expense of operating and maintaining general facilities or equipment for the use of all shops and departments, such as railway tracks, roads, yard cranes, general yard labor, floating property, railway freight service, etc.

General Expense and Shop Expense to Be Distributed to Production Orders

By the methods outlined only general expense and shop expense are distributed to production orders. These are distributed at the end of each month as previously described in this article. While the storehouse expense is distributed to material issued for production orders, for convenience it is found best in practice to distribute this at the end of each month as a percentage on the total value of the material charged to each production order. It will, therefore, appear on the cost of work card as an indirect expense. With the distribution of these indirect charges to production orders the total factory cost is shown; but to obtain total cost the selling expense must be included.

Selling Expense

As a monthly balance sheet is desired, the selling expense should be distributed each month. This can be applied to the product actually sold, which is the proper way for a manufacturing concern like a machine-tool builder. In a jobbing repair shop, or in an establishment like a ship yard, where there is both repair and construction work and where contracts require several years to complete, it is impracticable to distribute the selling expense to the product sold. In these cases the selling expenses should be kept separately but should be merged with the general expense and distributed with it. The factory cost will in these cases then include the selling cost.

Apprentice Training Room in a German Machine Shop

The apprentice shop established at the works of Borsig at Tegel, near Berlin, Germany, is intended for the training of apprentices in, fundamentally, the same way that this could be done in the large shops of the works, and further, during the first half of their apprenticeship, to protect them against possibly injurious influences. The firm, by this means, insures to itself a force of reliable and intelligent employees, since experience shows that a high percentage of the apprentices remain in its service after the termination of the apprenticeship period.

The training room, in which can be placed about 100 apprentices, is separated from the other shops and contains, besides the machine tools and work benches, toilet rooms for washing, dressing, etc. Outside is a well cared for piece of garden land, provided with seats for the apprentices during their intervals of rest.

The instruction is supervised by an over-engineer, a specially competent master fitter and two other instructors, trained machinists.

The machinery equipment is as follows:

(a). For the fitter apprentices, one planer and two shapers, three drilling machines, one milling machine.

(b). For the lathe-hand apprentices, about 20 lathes, including one boring mill; one drilling machine, one grinding machine, one semi-automatic turret lathe.

For the apprentices in section (a) is provided also a laying-out table.

It is proposed to establish a small blacksmith shop and a hardening room. Among the machines are those most generally used, and, in part, of the latest type, which promotes a reasonable quality of work.

The fitter apprentices are partly employed in building small air compressors, pumps and steam engines, the larger pieces of which, being beyond the capacity of the apprentices' tools, are furnished by the other shops. They are also employed, however, in making pieces called for by other departments of the plant.

The apprentices are received in the spring and autumn, at which times 25 fitter and 5 lathe-hand apprentices are taken on. Fro this purpose a factory apprentice indenture is entered into with the father or guardian and is signed by both parties. This contract complies with the legal provisions for such cases.

Apprentices are not regularly received before the completion of their fourteenth year, nor after their sixteenth year. During the first two years the instruction is given only in the training room, while

during the last two years the boys are further trained in other departments, complying so far as may be with their own preferences. In the fourth year some specially bright apprentices are picked out to instruct the younger ones.

As provided for by the indenture, a fee is not required by the firm, but on the other hand, the apprentices are allowed hourly wages: during the first year six, in the second year nine, the third year twelve, and the fourth year fifteen pfennigs. (A pfennig is about one-quarter of a cent.) Further, one pfennig per hour is credited to each apprentice as a bonus to be paid at the end of his term, then amounting to 90 marks (about $22). This provision is intended, in part, to indemnify the firm against possible malicious damage to its property by the apprentice.

Besides their training in hand work, the apprentices are disciplined to good behavior toward those above them and their fellow workmen, and especially to a love of good order. Each, before the close of work, is required to clean his machine or place of work. Two apprentices, changed weekly, are assigned to clean the passageways between the machines, etc. Every Monday morning it is required that the overalls have been washed.

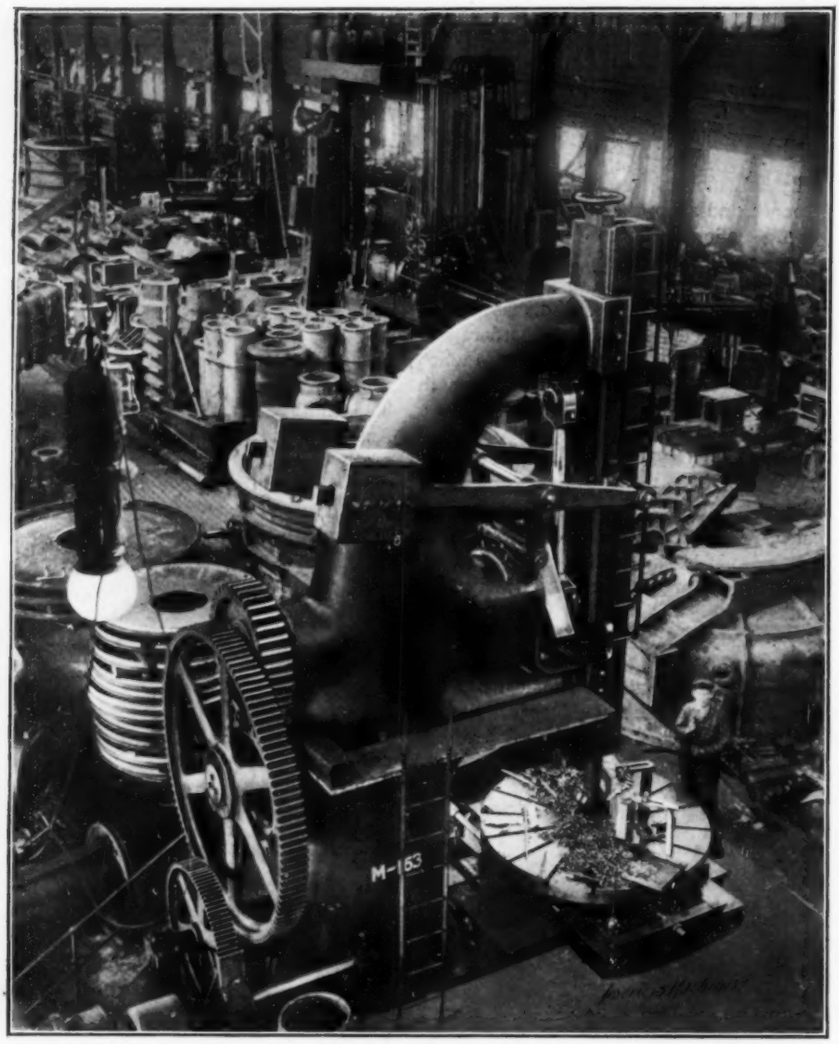
The apprentices, moreover, are required to attend continuation schools, for which purpose they are allowed to leave the shop when necessary. A record book placed before the shop officials shows the regularity of school attendance.

A Noteworthy Slotting Machine

Special Correspondence

An early example of heavily designed machine, built in 1864 and recently placed in operation with one or two minor changes, to handle modern work.

The accompanying halftone illustration shows a very large slotting machine recently installed in the main bay of the machine shop at the Fore River Shipbuilding Company, Quincy, Mass. This slotter is of interest and is noteworthy because of its size, as indicated in the photograph by referring to the man who stands in front of the table, by its design, the lines of which are surely pleasing, and by its age. This machine was recently purchased by the Fore River yard from the Charlestown, Mass., Navy Yard.



A Slotter Built in 1864 and Still in Use

At about the close of the Civil War, the Charlestown yard purchased a large number of heavy machine tools with the expectation of using them in the building of engines for war vessels. The close of the war rendered these tools of very little service, yet they stand out as one of the most remarkable collections of large machine tools that have ever been built. The slotter which is shown in the illustration is one of the machine tools that comprised this memorable group, and is interesting not only historically but for its present capacity.

A request for information in regard to it brings out a single fact from the Charlestown yard; namely, that this machine was built for the Navy Department in the year 1864, by the Boston Machine Company.

It is interesting to note that the slotter went into use at the Fore River yard with very few changes, other than to rebuild the counterweights and counterweight levers and attach an electric motor for direct driving. The work upon which it is engaged, as shown in the illustration, is cutting the teeth in a section of a battleship turret rack.

The Weight of a Heavy Rainfall

In a recent, much needed rainfall in eastern New York, the gages registered a total of three inches in 24 hours. As the area of Manhattan island is 22 square miles, this would amount to 4,780,000 tons of water falling on the island alone, or just over one ton for each inhabitant of all the five boroughs of Greater New York City. This will undoubtedly cause the Manhattanite to be even more proud of himself than ever.

Taking the figures for the total area of Greater New York City; 326 square miles, a total of 70,900,000 tons of rain fell, supplying enough water to fill a lake four miles long by two miles wide, to an average depth of 10 feet.

Examples of Precision Grinding*

By W. A. Viall†

The principles of grinding are not difficult to grasp, but the doing of the work requires such knowledge and skill, acquired by experience, that it should be classed among the arts.

A table of grinding limits for cylindrical work and numerous examples are given.

*Presented to the American Society of Mechanical Engineers.

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The principles of grinding, in the main, are not difficult to grasp, and the time that would be required of the ordinary chief operator in grasping them is not excessive. But the work does require such attention and knowledge of the results that can be obtained, coupled with the skill acquired by experience, as to class it with the arts. In the early days it seemed quite necessary that for every different piece of work we should have a different wheel. Later it was found that a given wheel would give satisfactory results on various kinds of work by varying the speed of the wheel, the speed at which the work was run, or the feed of the work, so that one wheel answered a great variety of purposes. There have been changes in abrasives and we are getting today a far better quality of wheel than was possible some years ago. The grading of wheels has very much improved, and although in the writer's opinion it is not possible to obtain an absolute grading, this element has been reduced to such a nicety that it need not be taken largely into account by the average operator.

The first use of the grinding machine as we know it today was to correct slight errors that were impossible of eradication by means of the file and emery cloth. Today the grinding machine rectifies these errors and in addition finishes work for appearance and fit in a relatively cheap manner.

After the proper machine has been selected, the choice of wheels requires some specialized knowledge which the makers of machines and wheels are in a position to furnish to an extent that many of the users of machine tools are probably not aware. When the proper wheels and gradings are once established for a given line of work their subsequent use is very easy.

The question of speeds and feeds is also the result of experience, and suggestions from the manufacturers will help users to a great extent in obtaining satisfactory results. The cutting operation of the wheel was well shown in an illustrated article by Messrs. Gribben and Warman* where the microscopic photographs showed that the chips somewhat resembled those made by a lathe tool. It is only under proper conditions, however, that these results can be obtained. The wheels must be true and they must not be forced into the work to too great an extent, for this produces a torn effect upon the work, which is to be avoided.

Grinding Limits for Cylindrical Pieces

In considering a piece of work to be done, first of all the question arises as to the size and the limits suitable for the purpose for which it is intended. Table 1 gives the limits used at the Brown & Sharpe Manufacturing Company's works for varying conditions. There are special cases where it may be necessary to increase or to decrease these limits, and this table is not offered as the final word but as a guide toward selection.

The second necessity is that sizes should be established to which the work should be rough turned ready for the grinding room. In our works, as in all factories, the aim is to produce the desired results as cheaply as possible. Our desired ends have been accuracy and nicety of finish where the parts ground are for fits, and nicety of finish where no fit is required. To do this work as cheaply as possible we believe that it is

*American Machinist, Vol. 26, page 942.

RUNNING FITS—ORDINARY SPEED		
To ½-in. diameter, inc	0.00025 to 0.00075	Small
To 1 -in. diameter, inc	0.00075 to 0.0015	Small
To 2 -in. diameter, inc	0.0015 to 0.0025	Small
To 3½-in. diameter, inc	0.0025 to 0.0035	Small
To 6 -in. diameter, inc	0.0035 to 0.005	Small
RUNNING FITS—HIGH SPEED, HEAVY PRESSURE AND ROCKER SHAFTS		
To ½-in. diameter, inc	0.0005 to 0.001	Small
To 1 -in. diameter, inc	0.001 to 0.002	Small
To 2 -in. diameter, inc	0.002 to 0.003	Small
To 3½-in. diameter, inc	0.003 to 0.0045	Small
To 6 -in. diameter, inc	0.0045 to 0.0065	Small
SLIDING FITS		
To ½-in. diameter, inc	0.000 25 to 0.0005	Smal
To 1 -in. diameter, inc	0.0005 to 0.001	Small
To 2 -in. diameter, inc	0.001 to 0.002	Small
To 3½-in. diameter, inc	0.002 to 0.0035	Small
To 6 -in. diameter, inc	0.003 to 0.005	Small
STANDARD FITS		
To ½-in. diameter, inc	Standard to 0.00025	Small
To 1 -in. diameter, inc	Standard to 0.0005	Small
To 2 -in. diameter, inc	Standard to 0.001	Small
To 3½-in. diameter, inc	Standard to 0.0015	Small
To 6 -in. diameter, inc	Standard to 0.002	Small
DRIVING FITS—FOR SUCH PIECES AS ARE REQUIRED TO BE READILY TAKEN APART		
To ½-in. diameter, inc	Standard to 0.00025	Large
To 1 -in. diameter, inc	0.00025 to 0.0005	Large
To 2 -in. diameter, inc	0.0005 to 0.00075	Large
To 3½-in. diameter, inc	0.00075 to 0.001	Large
To 6 -in. diameter, inc	0.001 to 0.0015	Large
To ½-in. diameter, inc	0.0005 to 0.001	Large
DRIVING FITS		
To 1 -in. diameter, inc	0.001 to 0.002	Large
To 2 -in. diameter, inc	0.002 to 0.003	Large
To 3½-in. diameter, inc	0.003 to 0.004	Large
To 6 -in. diameter, inc	0.004 to 0.005	Large
To ½-in. diameter, inc	0.00075 to 0.0015	Large
FORCING FITS		
To 1 -in. diameter, inc	0.0015 to 0.0025	Large
To 2 -in. diameter, inc	0.0025 to 0.004	Large
To 3½-in. diameter, inc	0.004 to 0.006	Large
To 6 -in. diameter, inc	0.006 to 0.009	Large
To ½ in. diameter, inc	0.00025 to 0.0005	Large
SHRINKING FITS—FOR PIECES TO TAKE HARDENED SHELLS ¾ IN. THICK AND LESS.		
To 1 -in. diameter, inc	0.0005 to 0.001	Large
To 2 -in. diameter, inc	0.001 to 0.0015	Large
To 3½-in. diameter, inc	0.0015 to 0.002	Large
To 6 -in. diameter inc	0.002 to 0.003	Large
To ½-in. diameter, inc	0.0005 to 0.001	Large
SHRINKING FITS—FOR PIECES TO TAKE SHELLS, ETC., HAVING A THICKNESS OF MORE THAN ¾ IN.		
To 1 -in. diameter, inc	0.001 to 0.0025	Large
To 2 -in. diameter, inc	0.0025 to 0.0035	Large
To 3½-in. diameter, inc	0.0035 to 0.005	Large
To 6 -in. diameter, inc	0.005 to 0.007	Large
To ½-in. diameter, inc	Standard to 0.0005	Large
GRINDING LIMITS FOR HOLES		
To 1 -in. diameter, inc	Standard to 0.00075	Large
To 2 -in. diameter, inc	Standard to 0.001	Large
To 3½-in. diameter, inc	Standard to 0.0015	Large
To 6 -in. diameter, inc	Standard to 0.002	Large
To 12-in. diameter, inc	Standard to 0.0025	Large

The limits given in the table can be recommended for use in the manufacture of machine parts to produce satisfactory commercial work. These limits should be followed under ordinary conditions. Special cases should always be considered, as it may be desirable to vary slightly from the tables.

TABLE 1. GRINDING LIMITS FOR CYLINDRICAL PIECES.

As Adopted by Brown and Sharpe Mfg. Co.

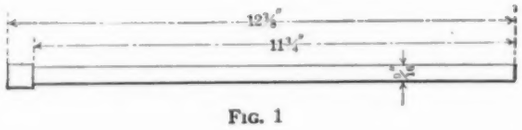


FIG. 1

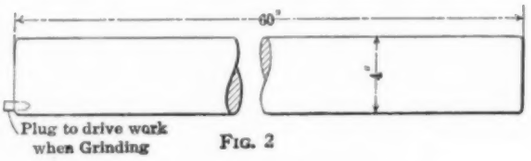


FIG. 2

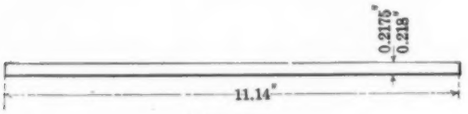


FIG. 3

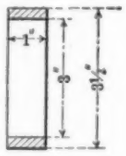


FIG. 4

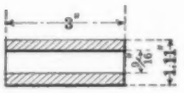


FIG. 5

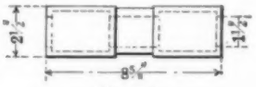


FIG. 6
American Machinist

EXAMPLES OF COMMERCIAL GRINDING

economical to turn the pieces to about the sizes indicated in Table 2. It will be noted that we allow from 0.008 inch to 0.012 inch in diameter, an amount easily obtained by the ordinary class of lathe help. In order to make this work as easy as possible for the lathe department, we furnish the limit gage shown in the sketch. We are aware that practice varies on this point, and we have thoroughly endeavored to try out the plan of allowing correct limits, but we have found it fully practicable to hold the lathe to the limits given. By so doing we obtain the finished product free from all tool marks and at what we believe is the minimum cost.

EXAMPLES OF COMMERCIAL GRINDING

Figs. 1 to 6 show some samples of commercial grinding taken from actual practice for the purpose of giving an idea of what can be done in a commercial way, as well as to give some definite data as to speeds, feeds, etc. While it is perhaps not possible to give a rule that will fit all work, these plates should suggest

Fig. No.	1	2	3	4		5	6	
Material.	Soft machinery steel.	Machinery steel.	Machinery steel, case-hardened.	Machinery steel, case-hardened.		Cast iron.	Bearing bronze.	
Part Ground	External.	External.	External.	Internal.		External.	External.	
Machine Used.	No. 11 Plain.	No. 28 Plain.	No. 11 Plain.	No. 1 Universal (Special).		No. 11 Plain.	No. 14 Plain.	
Wheel Used.	Monarch, 12 in. × 1 in. Corundum, No. 46, grade 2½.	Norton, 24 in. × 2 in. Alundum, No. 3846, grade K.	Norton, 12 in. × ½ in. Alundum, No. 36, grade 5, elastic.	Norton, 2½ in. × 2 in.; Alundum, No. 5, grade 2½ elastic.		American, 12 in. × 1 in. Corundum,, No. 46, grade K.	Abrasive, 18 in. × 1½ in.,Corundum, No. 60 grade L.	
Periphery Speed of Work, Ft. per Min.	35	35 roughing; 60 finishing.	35	100		55	75	
Travel of Work, In. per Min.	96	48 roughing; 30 finishing.	13	By hand.		37	30	
Periphery Speed of Wheel, Ft. per Min.	7000	6000	5500 to 6000	5500		6500	6000	
Amount of Stock Removed, Diameter.	0.012 in. roughing, 0.005 in. finishing.	0.025 in. roughing. 0.005 in. finishing.	0.005 in. roughing. 0.001 in. finishing.	0.018 in. to 0.020 in.	0.010 in.to 0.010 in.	0.020 in. to 0.025 in	0.012 in. to 0.015in.	
Number of Pieces Completed per Hr.	13	3.5	15	16	20	54	32 1 man.	59 2 men*.
Required Limit.	Standard to 0.00025 in. small.	Standard to 0.001 in. small.	Standard to 0.0005 in. small.	Standard to 0.0005 in. large.		Standard to 0.0005 in. small.	Standard to 0.0005 in. small.	
In Lots of	100	50	500	200		200	100	
Remarks.	21 roughed; 35 finished per hr. Handled twice.	7 roughed; 7 finished per hr. Handled twice.	Handled twice roughing and twice for finishing.				*A man operates the machine and a helper puts the work on and off the arbor.	

GRINDING RECORDS—SEE FIGURE 1 TO 6 INCLUSIVE.

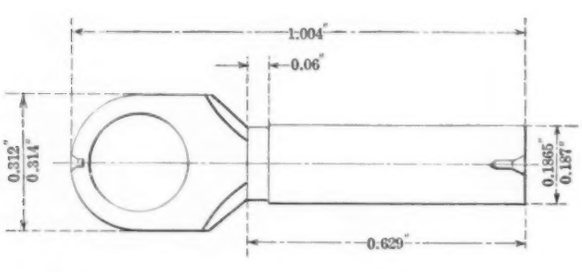


FIG. 7. SEWING-MACHINE PLUNGER—CASE-HARDENED

This piece is ground at the rate of 145 per hour. Only a small amount, 0.006 inch, is taken off to prevent grinding below the case-hardened surface. Ground on No. 11 Plain Grinding Machine. As this piece is only about 1 inch long it is quite difficult to handle, and this somewhat reduces the output.

An elastic wheel 36 grade 5 is used; speed of wheel, about 6000 feet per minute; speed of work, about 35 feet per minute.

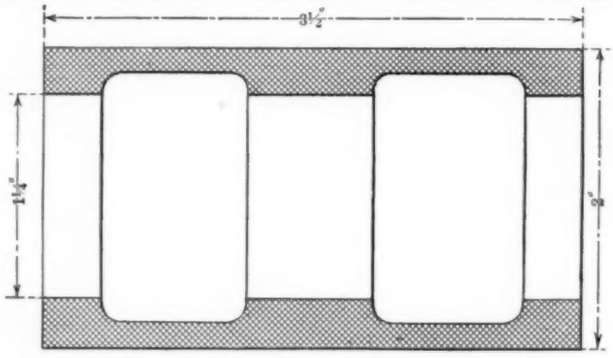


FIG. 8. BRONZE BUSHING

These bushings are ground at the rate of 30 per hour. Ground on No. 12 or No. 14 Plain Grinding Machine.

About 0.020 inch of stock is removed from the diameter. A 54 grade M American wheel is used; speed of emery wheel, about 6500 feet per minute; speed of work, about 70 feet per minute.

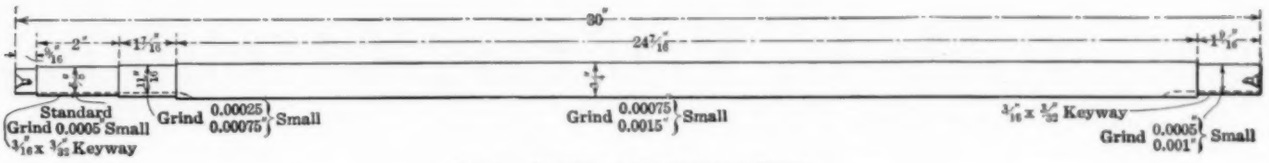


FIG. 9. SHAFT OF MACHINERY STEEL

These shafts can be finished down to size at the rate of 3 per hour. Between 0.010 inch and 0.015 inch of stock is removed from the diameter. A Norton wheel, 3836 combination L, is used.
Speed of emery wheel, about 7000 feet per minute.
Speed of work, about 55 feet per minute. Ground on No. 11 Plain Grinding Machine.

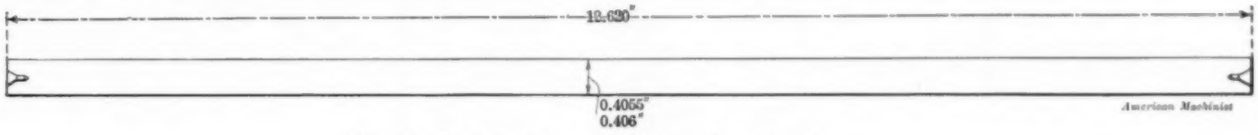


FIG. 10. SEWING-MACHINE SHAFT—CASE-HARDENED

These pieces are ground at the rate of 15 per hour. They are turned end for end for dogging in both the roughing and finishing operation; thus they are handled four times to complete. Only about 0.006 inch is left for grinding to prevent grinding under the case-hardened surface. These shafts are rough ground where there is so small an amount of stock for the purpose of breaking the scale the entire length before finishing. They are held to a limit gage ("Go on" and "Not go on"), and must be ground straight. An elastic wheel 36 grade S is used.
They are run through in lots of 500.
Speed of wheel, about 6000 feet per minute.
Speed of work, between 30 and 35 feet per minute.

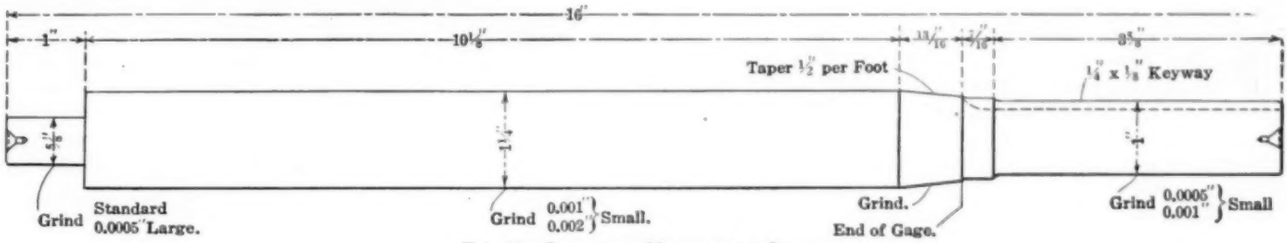
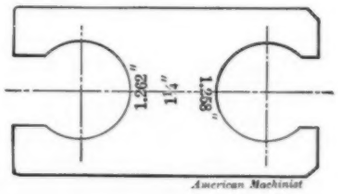


FIG. 11. SHAFT OF MACHINERY STEEL

This is a very difficult shaft to grind on account of the small diameter at one end, which gives a very poor support for grinding the larger diameters. It therefore takes about 1½ hours to finish one shaft.
The 2 5/16-inch diameter is roughed out first so that a back rest can be used. Each shaft is handled six times before it is finished, and from 0.015 inch to 0.018 inch of stock is taken off.
Speed of wheel, about 7000 feet per minute.
Speed of work, about 45 feet per minute. Ground on No. 12 or No. 14 Plain Grinding Machine.

ideas that will help in producing the work as well and as cheaply as this has been done in the cases shown. When enough pieces of any kind are to be made it is possible to specialize to a higher degree than can be done in the general run of work, and better results may be obtained than are shown here.

The examples of commercial grinding given in Figs. 1 to 6 illustrate what is being done under actual working conditions in commercial work on the variety of pieces indicated, which are of various materials, both soft and hard. A reversal of the usual rule, where economy is gained by having one man operate more than one machine, is shown in Fig. 6, where work is most economically produced by using two men to run one machine, that is, having one man to operate it and a helper to drive the work on and off the arbor. All other data are based on one man to a machine.



These pieces passed inspection within the limits given. The average loss from work of this class coming below the required limit or being otherwise spoiled is less than ¼ of 1 per cent. in our grinding department.

Figs. 7 to 13 are each notated to show the peculiar features that exist in the work, together with the data that may be of help in deciding upon other work of this class.

Size.	Not Go On.	Go On.	Size.	Not Go On.	Go On.	Size.	Not Go On.	Go On.
	Inches.			Inches.			Inches.	
3/8	0.383	0.387	15/16	0.9455	0.9495	1 1/2	1.508	1.512
7/16	0.4455	0.4495	1	1.008	1.012	1 5/8	1.5705	1.5745
1/2	0.508	0.512	1 1/16	1.0705	1.0745	1 3/4	1.633	1.637
9/16	0.5705	0.5745	1 1/8	1.133	1.137	1 13/16	1.6955	1.6995
5/8	0.633	0.637	1 3/16	1.1955	1.1995	1 7/8	1.758	1.762
11/16	0.6955	0.6995	1 1/4	1.258	1.262	1 15/16	1.8205	1.8245
3/4	0.758	0.762	1 5/16	1.3205	1.3245	1 7/8	1.883	1.887
13/16	0.8205	0.8245	1 3/8	1.383	1.387	1 15/16	1.9455	1.9495
7/8	0.883	0.887	1 7/16	1.4455	1.4495	2	2.008	2.012

TABLE 3. LIMIT GAGES FOR LATHE WORK.

Aeroplane Altitude Records

When we see in the paper that Johnstone has climbed in his aëroplane to the record-breaking altitude of 9714 feet above the earth, we all ask; why couldn't he go still higher? What holds him down, if his engine keeps on working? The answer is that at that altitude, the atmospheric pressure is only about 10½ pounds per square inch, making its density, or "consistency" only about three-quarters what it is on the earth. His propeller can get a purchase of only three-quarters to push against, and his planes have only three-quarters of the lifting power that they have at the ground level; while the weight to be sustained is reduced only about 1 per cent. by the distance from the earth.

Beside this, as the air gets rarer, the gasolene mixture for the engine becomes denser, tending to disturb its rather delicate explosibility in the cylinders.

Beside all this, again, Johnstone, himself, said: "It's as cold as —— up there!" This last, however, seems rather mixed, as to climatic conditions.

Essentials in Painting Machinery

By Herbert W. Rice *

Flat, partial gloss and high gloss finishes are used and have their especial fields. The beginning is a reasonably smooth casting, then a tenacious priming coat, then several coats of iron filler, then the finishing coats.

With suitable paints and methods a machine can be finish painted in a working day.

Careful painting helps to sell the machinery.

Within the past few years far more attention has been given to the painting of machinery than formerly. There was a time when even the most expensive machinery was given a coat only of the very cheapest paint, generally in a steel color, and usually drying without any gloss. This kind of painting can only be seen now, perhaps, on cheap cast-iron pulleys and then only in second-hand places.

But the modern maker of machinery wisely sees that it is foolish to spend thousands of dollars on the making of a machine and then daub it over with a cheap paint. Therefore, on the theory that a well finished machine creates a good impression and bears out the idea that attention is paid to every detail by the maker, much better painted machines are rapidly being produced by the more progressive manufacturers than was the case a few years ago.

To obtain this result it is necessary to use what is called an iron filler. This is an article sold in the paste form, which is thinned slightly by the painter into a sort of slush, and then flowed on with a brush with repeated coats until all imperfections have been filled up, and the surface leveled off by sandpapering.

We now have a foundation that is smooth and even where before it was rough. On this surface various styles of finishes can be applied, depending on the taste of the user.

*President and treasurer, United States Gutta Percha Paint Company, Providence, R. I.

Finish for Large Castings

On very large castings it is wise to use a flat or nearly flat finish; for the reason that a gloss magnifies all imperfections in the surface, and there is a sort of waviness in large castings which cannot be overcome by the filler. The filler fills in the depressions and evens up the rough surface, but the large waves, of course are still apparent and are even more manifest when a gloss finish is applied. A flat finish minimizes these waves, and gives a soft even look to the whole casting, no matter how many feet high or broad it is.

Finish for Smaller Machines

The next style of finish is called the "egg-shell finish" or partial gloss, and is perhaps the most modern and requires the greatest skill in manufacture of any. It is interesting to note how this came to be made by one of the largest producers of this kind of paint. A prominent machine-tool builder desired a paint of such a nature that when lubricating oil, either from finger marks in handling or from the bearings when testing the machine, touched the painted surface it would not show. This seemed an impossible requirement, because it was necessary not only to match the peculiar shimmer of an oily surface, but also the bloom of lubricating oil, and at the same time

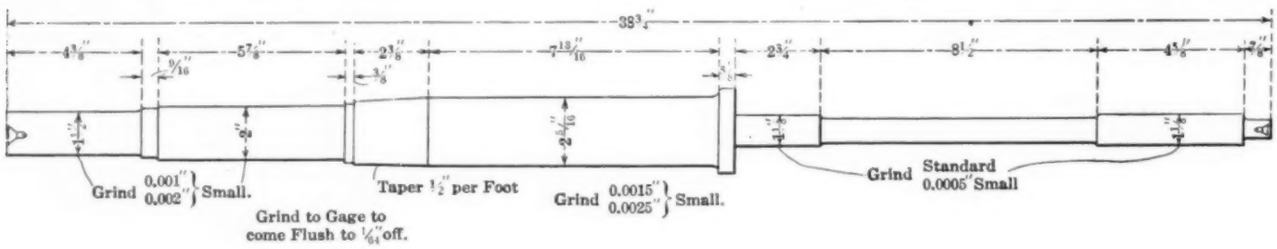

Grind 0.001" 0.002" Small.
Taper 1/2" per Foot
Grind 0.0015" 0.0025" Small.
Grind to Gage to come Flush to 1/64" off.
Grind Standard 0.0005" Small

FIG. 12. SHAFT OF MACHINERY STEEL

These shafts are ground at the rate of about 5 per hour. They cannot stand heavy cuts on account of having a small diameter at one end. The taper is ground to a gage and must be concentric. Each piece is handled four times before it is finished.
Speed of emery wheel, about 7000 feet per minute.
Speed of work, about 65 feet per minute.
Ground on No. 12 Plain Grinding Machine.

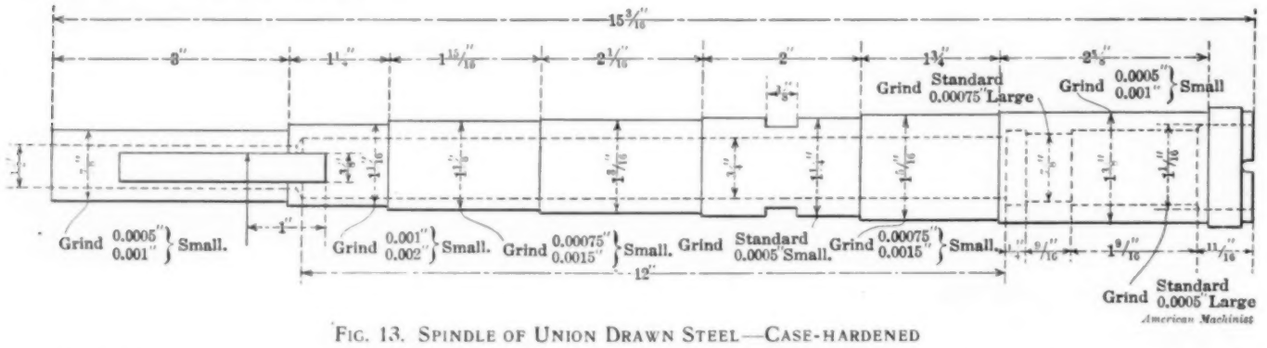


FIG. 13. SPINDLE OF UNION DRAWN STEEL—CASE-HARDENED

This spindle is ground both externally and internally. It is rough ground and then finish ground all over. A Monarch wheel 46-2¼ or a Norton wheel 3846 grade K is used. A very fine finish is produced. Note hole running entire length of spindle, also where cut away near small end and near middle, all of which adds to the problem of grinding.
One man grinds these spindles in lots of 50 in a little less than one-half hour each. Actual time, 50 in 24 hours. From 0.015 inch to 0.025 inch of stock is left on diameter for grinding and 0.003 inch or 0.004 inch is left for finish grinding. These spindles are ground internally on two diameters to a very close limit. These two holes must be exactly concentric and are therefore ground at one setting, at the rate of three per hour. Each spindle is handled 12 times before completion.
Ground on a No. 11 Plain Grinding Machine, and on a No. 2 Universal Machine for internal grinding.

make a paint impervious to it. This result, however, was finally accomplished. The test was to squirt oil from a can at various places on the machine thus painted and have a man wipe the oil off with a bunch of waste. The inspector then stood off and looked at the machine to see whether or not it had the appearance as it was when first painted and before the oil had touched it.

This, of course, required a special shade of egg-shell finish, but speedily there came a demand for the egg-shell finish in other shades, like black, steel blue, gray, etc., which while it did not match the color of the oil, yet made a better looking machine, and was oil proof in the sense that oil would not soak through such paint.

It requires, however, the greatest skill in making a partial gloss of this kind, for the reason that age is inclined to heighten the gloss into a full gloss, while if not properly made, or too near a flat it shows streaky. Moreover no matter how well made the egg-shell finish is it requires that the surface beneath it be absolutely non-porous. As it is generally applied over iron filler, which is very porous, it is therefore necessary either to use an intermediate coat, or else to use repeated coats of the egg-shell finish until an even result is obtained.

Here is where an experienced man can greatly aid the paint in getting all that a good paint is capable of furnishing, for like any other good thing, it can be abused and improper results obtained where care is not used in the application. The whole secret lies in preparing the surface over which it is applied, for the iron filler is necessarily thicker or thinner according to the depths of the depressions in the castings which it remedies. The deeper the filler the more it will suck out the liquid of the partial gloss finish in that one spot as compared with the surrounding surface. But an intermediate coat, such as is offered by the best makers of this line of goods, is made with reference to stopping the suction of the iron filler, and holding out the partial gloss applied over it, so that the same finish is obtained as would be secured were a piece of glass dipped into that partial gloss finish.

The Priming Coat

Back of all this is the necessity for a tenacious priming coat of paint underneath the iron filler, and directly on the iron. This we have mentioned last because it was necessary to show the amount of paint on these various coats which it is needful to apply in order to get a perfect surface, hence the necessity for great care being used in the priming coat, for if this does not hang on to the iron then all else will flake off, and the labor and material have been wasted.

Very little attention has been paid to this fundamental matter, either by painters in machine shops, or by the paint makers. There is one concern we know of that has gone into this matter very carefully, and has solved the trouble which has beset many users.

Almost any amount of time can be put in, in getting the best finish possible on machinery, like for example that obtained on carriages and automobiles. There, however, weeks are required to build up the surface, but there are limitations in regard to machine work which would prevent such time being spent.

Great care, therefore, has been used by some paint makers to produce material and a method of finishing which would be both speedy and safe. One of the largest users of this class of goods in the country on machines of average size, has produced remarkable results in point of time, using a special primer which dries very quickly. Over this two thin brush coats of iron filler are applied. The castings are pretty fair to start with, so these two coats are all that it is necessary to use. They will dry in four hours. Over the second coat is applied two coats of egg-shell finish or lacquer, which also dries rapidly, so that it is possible to turn out a machine thus treated within one shop day. Every coat is lightly sandpapered, and the finished result is a marvel, especially considering the time.

The High-gloss Finish

There is, of course, the high-gloss finish sold under the name of enamel, which is also used. This is so familiar that it needs little description. It is well for any maker of machines to go into the matter of painting carefully, for the cost per machine is extremely slight, both for material and labor, when compared with the value of the machine itself, and it certainly does help to sell the machine.

Influence of the Type of Building on Cost

By Herbert M. Wilcox

More important elements than the comparative cost of different building materials may have to be considered in deciding upon the type of construction for a factory. The relation of maintenance outlay to the net profits from a business has in recent years played an important part in the calculations of mill architects and engineers. The engineer has paid more and more attention to operating questions, and this more comprehensive view of the effect of particular types of construction on repairs and depreciation has greatly influenced his functions as designer and constructor.

The use of reinforced concrete for the entire Pierce Arrow Motor Car Company's Buffalo works, illustrates rather strikingly the way in which the operating knowledge of the engineer influences his construction practice. The chief interest of the Pierce Arrow plant is not the fact that it is one of the largest automobile factories built of reinforced concrete, but that concrete was adopted by the engineers, Lockwood, Greene & Co., of Boston, because their experience with the relation of types of construction to operating cost had convinced them that reinforced concrete in a metal-working plant was in the long run less expensive than the ordinary construction for this type of plant. Concrete costs more than wood, or wood and brick. A concrete mill, therefore, costs more at the outset than one of wood. But the wooden mill sways and vibrates incessantly under the running of machinery, and this vibration of the whole building adds a good deal to the inevitable wear and tear on the machinery. Hence the importance of lessening the cost, in time and money, of repairs to machinery.

A reinforced-concrete mill properly designed and constructed is monolithic, rigid, free from vibration. This rigidity means an important reduction in the cost of repairs to machinery. For some types of machines, and in some industries, reinforced concrete would not be worth while solely on this point of its rigidity; but for the metal-working plant rigidity is worth while, and means a saving which very soon overbalances the greater initial cost of concrete over ordinary mill construction.

In regard to the installation of machinery the difficulties which many mill men associate with the idea of concrete construction were easily overcome. Proper engineering foresight has provided in the various portions of the concrete structure the margin of strength, and the arrangement of reinforcement, necessary for the carrying of all the necessary motors and other power-transmission apparatus. The attaching of the various machines to the concrete floors—a job that somewhat terrifies the mechanic accustomed only to wood construction—has proved a vanishing difficulty. A small power drill was used to bore holes in the concrete almost as quickly as they could be driven in wood, and an expansion bolt in each hole gives a perfect anchorage.

There is a much greater coefficient of friction between the iron base of machines and a concrete floor than on a wood floor so that light-running machinery will not require as many anchor bolts. The absence of vibration of the building as a whole also removes the tendency of the machines to shift or "walk" on the floor from this cause. These details are referred to only by way of pointing out the fact that the supposed mechanical difficulties attending concrete mill construction are very easily met.

Letters from Practical Men

Concerning the details of making things in machine shops, from the first sketch to the shipping room.

A letter good enough to print is good enough to pay for. The value is in the idea—not the length of the letter.

Design of Friction Clutch

In the clutch shown in Fig. 1 four friction blocks *A* are pressed against a cylindrical friction surface *B*. The pressure is transmitted from the sliding collar *C* to the blocks by means of the elastic links *K*, as shown in Fig. 2. The method of design can best be shown by an example. Let the problem be the design of a clutch of this type to transmit 20 horsepower, at 200 revolutions per minute.

The twisting moment to be transmitted therefore is

$$T = 63{,}025 \frac{Horsepower}{R.P.M.} = 6302.5,$$

say 6300 inch pounds, or a force of 6300 pounds at one inch radius.

We will assume the diameter of shaft is

$$d = 2 \text{ inches.}$$

The diameter of the friction surface may be taken at ten times that of the shaft; or,

$$D = 20 \text{ inches.}$$

The tangential force at a radius of 10 inches will, therefore, be 1/10 that at 1 inch radius; or,

$$P_t = \frac{6300}{10} = 630 \text{ pounds.}$$

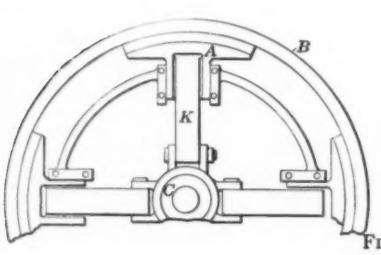


Fig. 1

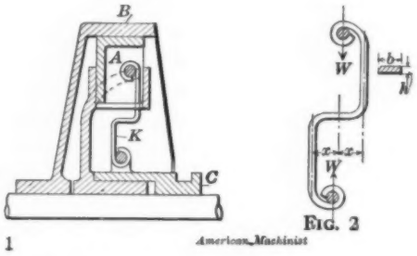


Fig. 2

Design of a Friction Clutch

The total radial, or normal pressure is;

$$P_r = \frac{P_t}{u},$$

where u is the coefficient of friction of the two surfaces in contact. This may be taken at 0.10 for cast iron on cast iron, slightly oily. Then

$$P_r = \frac{630}{0.1} = 6300 \text{ pounds;}$$

or for each friction block the radial pressure is

$$W = \frac{P_r}{4} = 1575 \text{ pounds.}$$

The dimensions of the friction blocks are readily calculated:

Let

l = Length of block, inches;

b = Breadth of block, inches;

p = Allowable pressure per square inch.

The pressure p varies between wide limits in practice, being very low where there is much slipping, as in automobile clutches. For ordinary use, and metal surfaces, it may be taken at;

$$p = 75 \text{ to } 150 \text{ pounds.}$$

Let us assume $p = 100$; then the area of each block is

$$A = \frac{Total\ pressure}{p} = \frac{1575}{100} = 15\tfrac{3}{4} \text{ square inches.}$$

The dimensions then may be taken; $l = 6$ inches and $b = 2\tfrac{3}{4}$ inches.

Fig. 2 shows a detail of the elastic link. From this it can be seen that the bending moment is $M = Wx$; where x is the dimension shown. Therefore $M = Wx = \tfrac{1}{6}bh^2f$; where b = width, h = depth, and f = working stress in the link material. The material used for these links is spring steel and f may be taken at 70,000 pounds per square inch; h may be from 3/16 to 5/16 inch, and x from 1 to 2 inches. Assuming $h = \tfrac{1}{4}$ inch and $x = 1$ inch, we obtain

$$b = \frac{6Wx}{h^2 f} = \frac{6 \times 1575 \times 1}{\frac{1}{16} \times 70{,}000} = 2\tfrac{1}{8} \text{ inches, about.}$$

The deflection of link, according to Bach, is

$$c = \frac{4}{E} \frac{Wx^2}{I} \left(\frac{x}{3} + \frac{L}{4}\right),$$

where

E = Modulus of elasticity;

I = Moment of inertia of section;

L = Straight distance between link pins, free, in inches.

To allow for wear of the parts, however, it is customary to make the deflection twice this amount, to start with.

Chicago, Ill. H. L. Nachman.

Weights of Iron and Steel Bars

Here are two rules which I have used many years in the forge business for obtaining the approximate weights of round and rectangular sections of iron or steel.

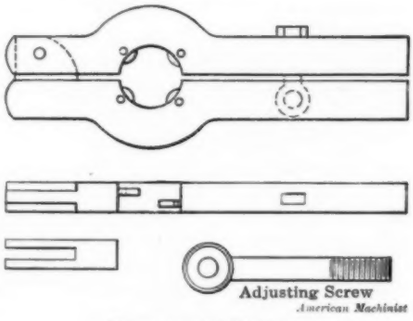
To obtain the weight per running foot of round iron or steel, square the diameter and multiply the result by 2⅔.

To obtain the weight per foot of rectangular sections, multiply the width by the thickness, and then multiply the result by 3⅓. While these rules are not absolutely accurate, they are quite near enough for ordinary purposes and may be useful to some of your readers.

Cleveland, O. R. S. Taffenden.
Cleveland City Forge and Iron Company.

Piston Rod Roller

The illustration shows a piston-rod roller that is made differently from those usually employed. This has four narrow rollers which are offset, as can be seen from the two views, and which can also be adjusted to any diameter of piston rod that is likely to be used.



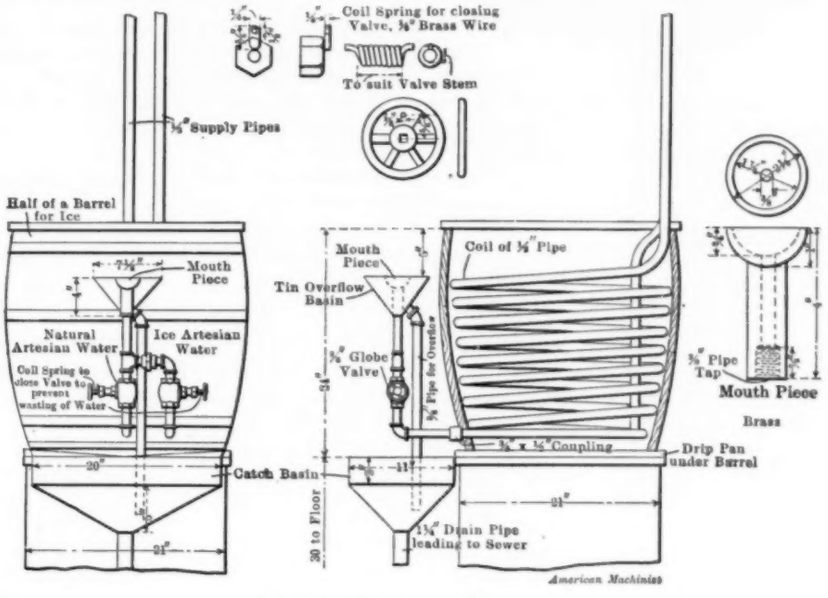
Piston-rod Roller

Rolling a piston rod seems to give the best finish for obtaining satisfactory wear and costs no more than the old method. The roller shown can be clamped on the rod with the long end resting against the tool post. By throwing in the carriage feed the roller will be fed along the rod in the same time as would be required for a cut and the result is much better than the old method of finishing by file and emery cloth between wooden clamps.

St. Paul, Minn. Thomas Rowe.

Sanitary Drinking Fountain

Accompanying drawing shows sanitary drinking fountain for shop, that we have made and installed, and which is very much liked by all concerned. It gives us pure, ice-cold artesian water, or the natural artesian water; or it may be mixed by opening both valves to produce water of temperature to suit the person. Before this fountain was made we had the same conditions as to water, but everyone had to drink out of one cup, which was objected to by all concerned.



SANITARY DRINKING FOUNTAIN

As our water is metered and paid for at meter rates, we designed the self-closing valves, as shown; otherwise the water would be left running, which was quite expensive and wasteful of water.

The funnel shown catches all waste water, which runs to sewer, and there is no wet and disordered floor around this fountain, as there used to be when cups were used.

Clinton, Iowa. CHARLES MARKEL,
Shop foreman, C. & N. W. Ry.

Anarchy among Gages Caused by Different Basic Temperatures

On the introduction of the metric system into Germany, 1872, the Imperial Standard Gage Commission handed down rules for the manufacturers of standard measures and for the officials concerned in testing measures of length, in order to insure the necessary agreement of all measures used in public trade with the standard in Government possession, and among themselves.

As, in conformity with the international unification, was laid down through the ruling No. 12 of Jan. 28, 1872, and by the Imperial law of April 26, 1893, the original standard is based upon a length of 1 meter (= 1000 millimeters) at 0 degree Centigrade—that is to say, the temperature of melting ice—and the same temperature is basic for all standard measures of trade.

In consideration of this rule, no measure can be given the official gage stamp if it does not comply with the requirements named, and indeed no other scales are used in Germany.

The highest authorities, the Imperial Standard Gage Commission and the Physical-Technical Imperial Institute, at Charlottenberg, test measuring tools brought to them by comparison with steel standards whose lengths conform to the Imperial law. In the testing room a temperature of about 18 degrees Centigrade rules and care is taken that the standard measure and the one under comparison have exactly the same temperature. The instruments that have been found correct in this manner will agree with the German standard at 0 Centigrade, and at all other temperatures, if they be made of steel or cast iron, since they have the same coefficient of expansion (0.011) milimeter per minute at 0 Centigrade).

To measurements in the shop, the same principles apply: If the piece of work and the measuring tool, assumed to be of the same material, agree at a certain temperature, they will also agree at any other temperature met with in practice. The measurement can, therefore, with equal correctness be made at 10 degrees Centigrade, for example, or at 25 degrees, so long as the measure and the compared object have the same temperature.

It, therefore, passes comprehension how individual manufacturers of gages and scales can choose for their instruments a standard that is exactly 1000 milimeters long, not at 0 Centigrade but at some other assumed temperature, such as 20 degrees Centigrade. A plug gage, for illustration, of 100 millimeters diameter, which corresponds to its nominal size at 20 degrees Centigrade is about 0.022 millimeter too small as compared with the German Imperial standard, that is to say, with the measures generally used, which is a far greater error than the allowable inaccuracies.

The buyer of such a tool, who generally is left in complete ignorance of this capriciously chosen temperature, has then two or more measuring systems in his shop, and will never get out of his troubles, since these systems are at variance and the production of interchangeable parts becomes altogether uncertain. If he wants to have such a measure officially tested, his desire cannot be granted, because only those measures are competent to be calibrated which correspond to their nominal value at 0 degree Centigrade. Furthermore, we are not to be surprised if the so called working temperature on which many makers of scales base their product is in one establishment 14 degrees Centigrade and another 16 or 20 degrees, which goes to show how arbitrarily these temperatures are chosen and what dangers they bring.

It is, therefore, advisable to employ in practice only measuring instruments that correspond to the legal German Imperial standards, since on this basis alone is possible a standard measurement at any temperature, assuming only that measuring instruments and piece of work have the same temperature.

Esslingen, Germany. CARL MAHR.

[We print this as a side light on the use of the metric system in Germany.—ED.]

A Convenient Table of Logarithms

The New Britain Machine Company, New Britain, Conn., has issued a very convenient table of three-place logarithms on a celluloid card of a size that can be readily carried in a vest-pocket notebook, so as to be ready for use at any time.

While most of us are accustomed to five- or seven-place logarithmic tables, the publishers of this say very tritely: "Many engineering calculations start with an assumption and end with a reconciliation to some standard, so that it is a waste of time to carry out things too far. In a majority of cases a three-place table of logarithms will prove useful and answer every purpose. Problems that could be handled on a 10-inch slide rule may be solved with equal accuracy with this table." We presume one of these may be obtained on request.

Discussion of Previous Question

New York Central Apprenticeship

On reading through the course of instruction given to apprentices at the New York Central lines, described by Fred H. Colvin, on page 718, I was surprised to find on one of the typical problem and class sheets the following statement: "Force and power mean the same thing."

Now, on this side of the water almost the first thing a student of mechanics or engineering is taught and taught most emphatically is that force and power *do not* mean the same thing, and they are also warned to strenuously avoid the misuse of the word power. That such a conflict of statement by eminent authorities should exist is most unfortunate and to be deplored as not being conducive to a better understanding of the terms used in engineering circles for which a plea was made, if I remember rightly, only a short time ago in your paper.

In this country force is described as that cause which tends to produce or produces motion in a body upon which it acts, or which changes or tends to change the motion of a body. If the force, when acting against a resistance, produces motion in the body, then work is done. The rate at which this work is done is understood as power which appears to us as quite a different thing from force, having time for one of its factors, while force is entirely independent of time, as is also the work done on a body. Probably the statement may have been made in error; if so it is extremely unfortunate, especially for young students, as once a term of this description is learned and applied, or rather misapplied, it becomes a difficult matter to eradicate from one's memory and is apt to slip out unconciously. On the other hand the statement may have been made in all sincerity and can, perhaps, be justified from your points of view. If so, then I think it is time both our authorities discussed the question and arrived at a more satisfactory position than the present one. Personally I cannot imagine the two words meaning the same and I do not remember ever having seen either in your paper or any of your contemporaries what is usually understood as horsepower quoted as horseforce, which would be quite in order provided the words were generally accepted as meaning the same. I think it is quite clear that Watt himself did not mean to convey the idea when he applied the term horsepower in estimating the output of his steam engines, that

Letters from our readers showing how many men of many minds look upon various subjects opened up in previous numbers.

it was the mere comparative pull or push which the engine was capable of exerting.

ALFRED WILDGOOSE.

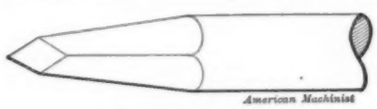
Manchester, England.

[The usage to which our correspondent rightly objects is a survival from an old practice used in connection with the simple machines ("mechanical powers") by which the applied force was called the power and the opposing force the weight. The practice leads inevitably toward confusion of fundamental ideas and should, long since, have been dropped. Our correspondent gives the correct definitions of force and power and to them even the most elementary teaching of mechanics should conform.—ED.]

Drilling Glass

The article by M. Clark, page 503, on drilling glass, reminds me of an unusual job which once came my way.

It was required to drill some 60 or 70 pieces of glass, 5/8 inch square and 0.006 inch thick with a 0.062-inch hole in the center. These were for reflecting mirrors in special testing machines and the chief



DRILL AND REAMER

trouble was the appearance of very minute cracks radiating from the hole after drilling, which resulted in fracture immediately the pieces were handled.

The cause, undoubtedly, was due to the drill breaking through as soon as the point was cleared, and the same thing continued, although drilling was tried from both sides, supporting the glass on hard wood.

Eventually, first-rate results were obtained by the following method:

Three or four laps were turned up 0.060 inch in diameter and drilled with a 0.040-inch hole. These were charged on the end with fine diamond dust and with a lubricating mixture of turpentine and camphor, were used to cut a faint circle on both sides the glass at the proper location for the hole. Then, when the holes were drilled, the usual radiating cracks were cut short at the circle and after reaming to full size a clean, round hole resulted. The type of drill used is the best of several tried and just as efficient for large as for small holes. It is quickly made and the sketch hardly needs description.

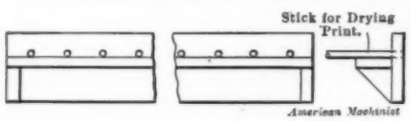
It can be made from drill rod, filed square and the end finished to a diamond point.

Naturally, the glass pieces were silvered after drilling.

Newark, N. J. NORWOOD.

Substitute for Blueprint Wringer

In the AMERICAN MACHINIST several weeks ago, C. P. Harrison described an arrangement for drying blueprints. I have seen such a device in use, but considerably simpler. In the blueprint room there is considerable wall space made of bevel siding. The blueprints from the water-tank simply are flopped against this wall, face in, where they stick. An old towel is the squegee used in this case,



SUBSTITUTE FOR BLUEPRINT WRINGER

and a small tin gutter nailed to the wall carries off the water. In the winter time the damp prints are peeled from the wall, spread over the radiator and are ready for the shop in a short time after leaving the tank.

In the summer time, natural drying is employed, and a rather ingenious, but simple drying rack is used. As shown in the sketch, this consists of a shelf fastened to a board which in turn is nailed to the wall. Half-inch holes are drilled into this back board, tangent to the top of the shelf, and round half-inch sticks are used with this to dry the prints. The print floats flat in the water; a stick is slid under the middle and as it is raised, the print hangs smoothly over it. It then simply is shoved home in the bracket and left till dry.

A good plan is to have a small bracket over the tank. A print may then be hung there until the greater portion of the water has dripped off, when it may be moved to the regular rack. If a print is wanted in a hurry, the above squegee,

wall process is used before placing print in rack.

Sticks for the rack may be kept in an old umbrella stand, or a nail keg will do. Right here is where the beauty of the rack comes in; when not in use it takes up no room, and when filled with drying prints it would be hard to find any rack taking less space to do the same work.

Milwaukee, Wis. JOHN BAILEY.

Skew Teeth in Hobbed Gears

An article on the above subject, by George B. Grant, which appeared on page 421, begins as follows: "The theory of the hobbing gear-cutting machine says that you can plump the hob right into the work just anywhere and without bothering to center it, as must be done when using the ordinary single cutter." Mr. Grant then proceeds to demolish this interesting theory and concludes his article with the words, "Perhaps I am the discoverer of the cause of the 'flat' and of the reason for the 'skew.' I have not seen any prior publication on either item."

The makers of gear-hobbing machines are not, however, so ignorant of the principles of the machines they manufacture, as Mr. Grant in this and his previous articles seems to suppose. As regards the flats, I have already referred him to my article in the AMERICAN MACHINIST, Volume 32, Part 1, page 126, in which I gave an explanation of the flats before Mr. Grant had written on the subject. The flats were also particularly referred to and an explanation of them given by T. Humpage, in a paper on "The Evolution and Methods of Manufacture of Spur Gearing," read by him before the Institution of Mechanical Engineers, at Bristol, in July, 1908.

As regards the skew teeth, it seems scarcely possible that even the most careless user could go on cutting wheels for several weeks, as Mr. Grant suggests, without finding out for himself the necessity of centering on tooth of the hob. Certainly it will come as news both to users and makers in this country that the theory of gear hobbing ever disregarded this necessity.

Is Mr. Grant unaware of the fact that Messrs. Schuchardt & Schütte, who have been so largely responsible for the introduction of this type of machine, have always supplied a special device to attach to the table of the machine for the express purpose of centering the hob? All the gear-hobbing machines manufactured by my own firm, Humpage, Thompson & Hardy, of Bristol, are fitted with a very simple and effective form of centering device and in the printed instructions sent out with every machine, special attention is drawn to this point.

The absolute necessity of centering the hob was also pointed out by Mr. Humpage in the paper above referred to.

Bristol, England. P. A. THOMPSON.

Gear Tooth Standards

In discussing the question of the most suitable form of gear tooth with a well known rolling-mill engineer, several points were brought out which should be of interest, in view of the present discussion on this subject. The question was asked, "Why do you not use the Brown & Sharpe standard?" His reply was as follows:

Well, to begin with, we do not know what the Brown & Sharpe standard comprises. Again, for heavy work we cannot afford to use any system that sacrifices the greater part of the tooth surface and gives such a weak flank for a small number of teeth. If the tooth is modified to avoid part of this undercut, the result is disastrous, as the true involute form is absolutely necessary for a smooth operating gear. No other condition will be considered. If there is a method of modifying the 14½-degree system and avoiding these objections, we would be very much pleased to know what it is.

The fact that this is a trade secret of some one cutter manufacturer does not assist us in our cast-tooth work, where we must build up our own tool outlines. An angle of 20 degrees, with an addendum of 0.250 of the circular pitch, is practically in universal use for gears heavier than one diametral pitch. For roll pinions an angle of 22½ degrees, with an addendum of 0.275 of the circular pitch, is standard.

By using the 20-degree short tooth we secure a greater amount of rolling contact and use the tooth its full length. The 20-degree tooth will wear longer and is cheaper to cut or cast. It is also an extremely simple matter to make templets that will produce smooth running gears, as we make absolutely no departure from the theoretical form of tooth. No perceptible difference can be noticed in the general wear between the use of the 14½-degree and the 20-degree tooth. And last, but not least, we gain on an average of 40 per cent. in strength, consequently we can use more gears. The engineer using the 14½-degree standard cannot compete with the engineer using a 20-degree tooth. This is an objection to the 14½-degree tooth that comes very close to our pocketbooks.

We would not, unless specified, use a 14½-degree tooth on gears heavier than one diametral pitch. Below this temptation is to use stock cutters, also the objection to the cost of special form cutters, which is the classification under which cutter manufacturers style 20-degree cutters.

MAKING OF CUTTERS BY THE GEAR MANUFACTURER

Referring to the article which appeared in the AMERICAN MACHINIST, page 715, C. R. Gabriel, in a discussion of this subject, could not understand the advantages of the gear manufacturer making his own cutters. I quite agree with him up to a certain point, say up to one diametral pitch. Cutters up to and including this size, are regularly carried in stock and are, therefore, quickly attainable, except, of course, for odd pitches or for special numbers of teeth. Also, it does not pay the gear manufacturer to make his own cutters, as he has not the facilities; but how about formers for gear planers, which are made of cast iron and inexpensive? Is the cutter manufacturer required to purchase these from a reliable cutter manufacturer and wait on his delivery?

Again, gears are cut up to 7 inches circular pitch, with a rotary cutter. Such cutters are not regularly carried in stock and are made in the form of blades which are set in the stock hub or center, which will acommodate a variety of pitches. These blades cost far less than a solid gear cutter and are equal in service, therefore vastly preferable. They can be quickly and cheaply made by a simple process, the only objection to their use would be that Mr. Gabriel's reliable cutter manufacturer, will not divulge the outlines of the 14½-degree tooth.

The very secrecy which surrounds the Brown & Sharpe system has been the cause of its undoing, for heavy work at least. The question of standards has practically settled itself, in the Pittsburg district.

Suppose for the sake of an argument that it is as Mr. Gabriel states, that the Brown & Sharpe system will hold its own against any system for general machinery and that the benefits of modification are more real than imaginary. Does he suppose for a minute that the gear manufacturers are going to meekly buy all cutters, formers, blade templets for their cast-steel work from one concern, in view of the fact that it will pay them to make all but the smaller-sized cutters in their own shop? This alone is enough to kill any system, no matter how desirable. And not knowing how to avoid the difficulties attending the use of the Brown & Sharpe system, the engineer and designer have naturally looked toward a means of avoiding undercutting, by increasing the angle or shortening the addendum, or both.

THE MODIFIED INVOLUTE

The prevailing impression seems to be that the Brown & Sharpe system is a modification of the involute, that is, an involute tooth, changed in some indefinite manner, that will, like as not, result in an irregular impulse being delivered to the driven gear. It is very probable that

any modification of the true involute would give this result. Now I have no idea how Brown & Sharpe accomplished this but it might be reasoned as follows:

The involute curve is, in reality, but a limiting case of an exterior cycloid, which would be termed an epicycloid, as the straight generating line used for the involute may be considered as a curve, or circle, of infinite radius. In the cycloidal system a describing circle is made so small that it may be rolled within the pitch circle of the smallest gear in the system where it describes the interior cycloid or hypicycloid, which is engaged by the exterior cycloid or epicycloid, described by rolling the same describing circle on the outside of the pitch circle.

When the describing circle is made of infinite radius (a straight line) it cannot be rolled inside the pitch circle to form the interior cycloid, therefore the pitch diameters from which the exterior cycloid is described must be separated so that the exterior cycloids will engage each other. This is the involute.

To secure an involute system, without undercut, this circle must fall below the working depth of the tooth; in the 14½-degree system this condition is met at 30 teeth. There can be no contact of any value below this base line, therefore, all that is required of this portion of the tooth is that it does not interfere with the engaging teeth and that it is not difficult to form. This is the objection to the theoretical 14½-degree tooth, as it is both difficult to form and has considerable undercut. To correct the 14½-degree system, the flank of the tooth below the base line could be predetermined, that is made any form desired, and enough curvature given the generating line to round off the points of the teeth so that they will not interfere with the flank, which has been laid out. A basis for this system could be determined by making the templets for 12 and 134 teeth. In other words, rolled surface instead of a straight line form the base line of the gear, bending the straight line into the form of a circle until the gear teeth will not interfere with the flanks of the pinion. This bent line will represent a segment of the describing circle for that system. This has a tendency to lessen the obliquity of action and increase the arc of approach. In a model of 11½ inches pitch 9 feet diameter with a describing circle of 3¼ inches in diameter, the teeth being carried to a point, the action is continued but the teeth would lock on entering, unless assisted.

Again referring to the Brown & Sharpe system, I had occasion to order two cutters which were to be made exactly right for 34 and 79 teeth, 1½ diametral pitch. After the gears were cut and in operation, it was found that they were using but two-thirds of the full depth, their points having been eased off to that extent. Why should this be the case? The tooth enters contact easily enough, without this correction, and unless deflected by heavy loads, which should never be the case, will not interfere if made to the true involute form. It is not a matter of sticking to the true involute for theoretical reasons at a sacrifice of a practical tooth, as Mr. Gabriel and Mr. Burlingame would imply in their discussion of this subject, but sticking to it for practical reasons, as well as for theoretical, the supremacy of the generated bevel gear, which is a theoretical tooth, pure and simple, is proof enough of this. Instead of rounding off the teeth to prevent such interference, why not cut it off at the point where the rounding is started? What is going to happen when the tooth is a little worn and still more liable to deflection? This is worth thinking about. The old practice of rounding the extreme corners of the teeth would seem to cover all the requirements along this line.

Getting back to the cutters for 34 and 79 teeth, it was later required to cut an 80-tooth, 1½-diametral pitch, for which the 79-tooth gear seemed admirably adapted. It was found, however, that before this gear would run with a pinion cut with a stock cutter it was necessary to remove about 0.05 inch from the points of the gear teeth, increasing the space at the top of the tooth 1/10 of an inch. This was done with the cutter which is regularly carried in stock for cutting to 54 to 134 teeth. I give this for what it is worth but it doesn't say much for the system in vogue, whatever it is.

The objection to the shortened tooth, on account of journal wear and the supposed liability of the tooth to come out of contact, does not hold good for heavy pitches where the proportion is different, for instance, on a 10-inch pitch tooth, having a depth of 5½ inches, the greatest possible separation of the axes can have no effect of any account.

New Standards

In conclusion, I would suggest that two standards be adopted, first, a 20-degree tooth with an addendum of 0.25 of the circular pitch; second, a 22½-degree tooth, with an addendum of 0.275 of the circular pitch; the first system, of course, being for general use and the second for roll pinions and like work where the number of teeth is low and the centers are close.

Pittsburg, Penn. Chas. H. Logue.

Which Side Up for the S-Wrench?

Referring to the note on adjusting the jaws of the S-wrenches (page 737) I, in common with most spanner users, have been bothered by the jaw moving the wrong way when first operating the screw; but not since noticing the fact that turning the screw *up* moves the sliding jaw to the *right*. This holds good whichever side up, or end up, you hold the wrench.

All you have to do to remember this is to think of the word *upright*, and after a few times it comes as natural as closing a vise.

This is a small matter, but if it saves a little irritation, only once a week, it is worth while.

London, England. B. Lawrence.

Finding the Square of a Number and of a Number and Fraction

After reading on page 644 of the American Machinist, F. J. Sepas' method of finding the half of an odd number and a fraction, I am inclined to think that the following method of finding the square of a number, and of a number and fraction, may be of interest and use to many readers, especially as a great saving of time is effected thereby.

The square of any number, $n = (n + x) \times (n - x) + x^2$; thus, $98^2 = [(98 + 2) \times (98 - 2)] + 2^2 = (100 \times 96) + 4 = 9604$. This, perhaps, looks to be quite a long method, on paper, but can, of course, be done mentally in two or three seconds.

Likewise; $45^2 = [(45 + 5) \times (45 - 5)] + 5^2 = (50 \times 40) + 25 = 2025$.

This rule also holds good for fractions; thus, the square of $4\frac{1}{2} = [(4\frac{1}{2} + \frac{1}{2}) \times (4\frac{1}{2} - \frac{1}{2})] + (\frac{1}{2})^2 = (5 \times 4) + \frac{1}{4} = 20\frac{1}{4}$.

Also, $(4\frac{1}{4})^2 = [(4\frac{1}{4} + \frac{1}{4}) \times (4\frac{1}{4} - \frac{1}{4})] + (\frac{1}{4})^2 = (4\frac{1}{2} \times 4) + 1/16 = 18\ 1/16$.

This principle may be modified to include cubes, but is a little more complicated.

Essex, England. L. Nikcul.

Industrial Education

Industrial and technical education has the great merit, not merely of not alienating young men from manual labor, but of keeping them in constant touch and sympathy with it, requiring them to practise the simpler mechanical operations as a part of their curriculum, and training them meanwhile to take up more complex varieties as a life work after graduation. There can be no manner of doubt that practical and technical education, while giving the individual student an excellent mental discipline, has also stimulated the agricultural and manufacturing industries of the country. And at the same time, by binding together the skilled hand and the educated brain, it has wrought powerfully for the maintenance and diffusion of the spirit of social and political democracy.—*President Schurman, of Cornell, in annual report.*

Employers' Liability Insurance

By J. D. Cox *

An address before the Foremens' Club of Cleveland, O., setting forth the problem of insurance with special reference to employers' liability.

A plea for a National Accident Insurance Bureau in which employers and workers participate, as the proper solution.

*President, the Cleveland Twist Drill Company.

What is insurance? Every corporation or individual carrying on a manufacturing or commercial business or owning any form of property is sure sooner or later to meet with various kinds of losses. Some can be predetermined—such as depreciation—and can be provided for by setting aside each year out of the profits of the business a fixed sum, or a fixed percentage of the value of the buildings and plant, as a reserve fund. This amount must be sufficient to replace the worn out machinery and buildings, as fast as the natural wear and tear and decay destroy them. The life of the ordinary buildings is in the opinion of the best experts practically limited to 20 years, and the usual allowance for depreciation is 5 per cent. of their cost per annum. The amount charged to reserve for depreciation on machinery varies from 5 per cent. to 10 per cent., according to the kind of machinery used—the destructive nature of the work performed on it, or the chances that new and improved designs will render it obsolete long before it is worn out.

Insurance then, is the accumulation of funds to meet *certain known* losses. As a rule all business houses write off this depreciation and to this extent insure themselves, but there are other losses that may come, and funds must be provided to meet them. Your buildings may burn down, so you must accumulate funds for that, called fire insurance. Your boiler may burst, your elevators may fall, your treasurer may run away with your money, so you must insure against them all. Your customers may fail, so you must take out credit insurance. If your plant is destroyed by fire you lose your income until it is rebuilt and running again, so you take out income insurance.

You may be injured and incapacitated from doing business, so you take out accident insurance. Some of your men may be injured or killed, so you take out liability insurance; and so on indefinitely, as the kinds of insurance are almost unlimited.

Uncertain Losses

From the above point of view we see that insurance is also the accumulation of funds to meet *uncertain* losses—uncertain as to the time when such loss may occur and uncertain as to the amount of the loss. Because these losses are uncertain it is not usual for corporations or business men to carry this risk themselves. The first requisite to a successful business is to know positively and accurately the cost of doing business—and as these losses are very uncertain, it is impossible to accumulate a fund that will positively and accurately take care of them. Even if you had such a fund you might not have to draw on it one year and the next year it might prove wholly inadequate to meet the unexpected calls on it, so you never could tell from year to year what the cost of doing business next year would be.

Another answer to the question is, insurance is the transfer of an existing risk from the person exposed to it, to another person or group of persons.

Why do corporations and business men insure? First; to protect themselves against unexpected and uncertain losses; second; so that they may know exactly what the cost of doing business will be. These two reasons are so interwoven that you cannot separate them. If a corporation is suddenly called upon to pay an unexpected loss, such as would result from fire, a boiler explosion, an absconding or unfaithful treasurer, or the claims arising from a bad accident; their calculations as to the cost of their product are all upset, and contracts that have been entered into with the expectation of making a profit are found to suffer a loss. In order, therefore, to know what the year's business will cost, prudent business men are forced to insure against many kinds of losses—each kind of business having risks peculiar to itself, but most corporations insure against fire, boiler explosion and accidents.

The Mutual Interest

The insurance company and the business insured are mutually interested in trying to make the risk good. The corporation or business man, because he wants the lower rate and the insurance company because it wants to avoid a loss. The insurance company sends to your plant periodically an expert skilled in detecting anything in it that may cause his company a loss, and he makes written reports to his company with recommendations of the things that must be done, or changed, to make the risk better. These recommendations are sent by the insurance company to the manager of the business insured, and if he is awake to his best interests he will proceed to carry them out, for the next time the inspector comes around he will have a copy of his recommendations with him, and the first thing he does is to check them up to see if they have been carried out. The insurance company and the business manager are working together to constantly reduce the chances that any loss may arise under the policy, whether of fire, explosion, elevator or accident.

Insurance, therefore, is a good thing for two reasons: It fixes definitely and in advance what the business must pay to be relieved of the risk; and is constantly, by bettering the conditions, reducing the risk.

Employer's Liability Insurance

Employers' liability insurance is comparatively new. It was introduced into the United States by an English company in the year 1886, or more than ten years after our business was established. My attention was called to this form of insurance many years later.

Under the common law in Ohio any person may bring a suit against any other person, or collection of persons, for damages for personal injury. The injured person can make his claim for any sum reasonable or unreasonable and trust to the sympathy of the jury to make a liberal award. The defendant can show by way of defense that there was no fault on his part, or that the plaintiff had neglected to take reasonable precaution, or that the accident was due to the fault of his fellow employees, or was due to the inherent or natural risks of the business which the workman assumed when he took the job. So a legal battle may go on, both sides hiring lawyers to present their case, the plaintiff working on the sympathies of the jury and possibly on their prejudice against corporations to get a large award; the defendant appealing to the good judgment and sense of fairness of the jury, to get the claim cut down, or have the case dismissed. After all has been said that can be said on either side and the jury brings in their verdict the judge may set it aside, when a new trial may take place after much delay, or the case may be settled by the lawyers out of court. Statistics show that in the great majority of cases the injured man actually receives but ⅓ of the amount awarded him, the balance being consumed in expenses, court costs, witness fees, lawyer's fees, etc.

This manner of settling damage claims has become most unsatisfactory to both the working man and the employers. To the injured workman because he has to engage attorneys, usually with the agreement that the attorneys should have a certain percentage of the amount collected, called a contingent fee, and because he never knows what he can rea-

sonably hope to secure. To the employer because he, also, has to pay an attorney to defend him, and never knows what amount he will have to pay as damages, and cannot even approximately determine the *cost* of *doing business.*

Our legislators have added many laws to our statute books but as a rule they have not helped matters at all, but have only made the settlement of damage claims more perplexing, more uncertain, and more expensive to both parties. The Norris law (in Ohio) takes away from the employer the right to plead as a defense—contributory negligence of the workman, or the assumption of the risks of the business by him, or an act of a fellow servant.

Nowadays, nearly every employer of any kind of labor takes out a policy in some company that writes employers' liability insurance for several reasons, but the first and most important reason is, that by so doing he fixes the sum to be paid for all such liability and charges it at once to his overhead expenses as part of his cost of doing business. Second, he takes this liability out of the class of uncertain risks and converts it into a known loss. Third, as he is but one of several thousand employers who take out policies in the same company, he is covering his liability or risk of a large loss with the smallest possible outlay of cash. Fourth, he is transferring the necessity of engaging a lawyer, the loss of valuable time attending court proceedings, the summoning of witnesses, etc., to the insurance company, which makes that its business, keeping as a part of its regular staff of employees skilful lawyers, physicians, nurses, etc.

They do *not* take out liability insurance, interposing between themselves and their injured employees, a third party, for the express purpose of relieving themselves of all expressions or acts of humanity or sympathy, as I have often heard it claimed.

Ambulance Chasers

There is unfortunately, a class of lawyers who live by prosecuting damage suits on the contingent fee plan. It frequently happens that an injured workman finds one of these lawyers at his home when he arrives there, the lawyer by an arrangement with the ambulance company or emergency hospital, having been notified of the accident.

Now the workman may know that his injury was all his own fault, or at least that it was no fault of his employers whatsoever, but the lawyer persuades him that he has a good case and may recover large damages and gets permission to bring a suit.

To protect themselves against this class of lawyers and their clients employers have been *forced* to insure.

Let me tell you of two acidents which I happen to know about.

One day the elevator bell rang. A man sweeping the halls climbed up on the lower rail of the safety gate—leaned over and looked down to see who rang the bell. The descending elevator caught him on the back of the head and would have killed him but for the quick presence of mind of a man who, coming down the stairs, saw his danger and reversed the elevator, saving his life.

I went into the engine room one day and saw a young man wiping a pump. He was leaning over it, with his left hand on a yoke, through which a plunger was moving backward and forward. I told him he must keep his hand off that yoke or some day he would get pinched. A few days later he was doing the same thing when his attention was attracted by something and he turned partly round to see what it was. His hand slipped and the plunger took off the tips of two of his fingers.

In the first accident cited the man was satisfied that the employer was not to blame and we had no trouble in settling everything to his entire satisfaction. In the second case a lawyer got hold of the young man—he refused any aid we could offer—and brought suit for $20,000 damages, claiming that he was studying to play the violin and his future prospects in that direction were ruined. This company up to that time had never carried liability insurance. This suit showed us how uncertain the risk was and we felt obliged thereafter to insure to protect ourselves against such unjust claims.

Compulsory Insurance

The older countries of Europe have laws compelling employers to pay injured workmen a compensation. In 1897 England passed a law that the employer must pay for the death of a workman three years wages—for disablement exceeding one week, half the average weekly wages; for permanent disablement, compensation for the rest of his life.

Germany has a system of compulsory insurance to which both employer and employee contribute. Every injured workman, no matter how he was injured—whether by his own fault, the fault of a fellow workman, or no one's fault—draws a regular weekly compensation until he is able to go to work again.

Last winter our State legislature (Ohio) passed a bill authorizing the Governor to appoint a commission to consider the question of compulsory compensation, and if they thought best to draw up a compulsory compensation act and present it to the next legislature for passage.

Splendid work is being done by numerous employers coöperating with their workmen in mutual-aid societies, relief associations and voluntary-insurance organizations.

Mutual Interest

Any State or national legislation along this line to be efficient must take into account all, or nearly all, present individual effort and be absolutely fair to both workman and employer. Every workman who owns a home or pays taxes on his personal property contributes something to the support of the State institutions for the blind, the deaf and dumb, and the insane. He should also contribute something to the fund upon which he may some day be forced to rely for his daily bread. His contribution to the fund will make him a partner in its collection, maintenance and distribution. He will be interested in seeing that every injured man gets his fair share, that he does not cheat the partnership by pretending to be more severely hurt than he is, that he gets back to work as soon as he is able, and that every man pays his dues. Every workman will be a part owner of the fund and when his turn comes to benefit by it he will take the sum awarded him as a recognition of his rights and not as an act of charity.

That workingmen are willing to contribute to such a fund is evidenced by the fact that nearly every factory has its mutual aid association. The Brotherhood of Trainmen voluntarily assess themselves $10 per $1000 of wages received, and in addition to that $2 per capita for administration expenses. The workman will outnumber the employer many times, and if interested in the fund, it will be very difficult for a dishonest official to go very far astray without someone in this great army finding it out.

In England there are well established cases where workingmen have deliberately disabled themselves—preferring half pay and no work to full pay and a day's labor; therefore, there should be a decrease in the amount of benefit to those who are negligently or willfully injured.

If the workman is interested in accumulating the fund he will be equally interested wherever employed in bettering the risk, and will voluntarily report all unsafe machines or appliances or buildings to the owners, employers or proper officials.

So I say the workman should insist on being interested in the collection, maintenance and distribution of the fund.

Present Methods Waste Two-thirds

That this fund will be a very large one is evidenced by the fact that in New York State during the year 1909, employers paid in premiums to the liability-insurance companies $25,000,000, out of which the injured workmen received but $8,000,000, the balance, or $17,000,000, being divided between the cost of doing business and profits. Under a properly drawn compulsory compensation act the employer would pay less—the injured men would receive much more.

The premium charged by liability-insurance companies varies according to the risk—whether good, bad or medium, and each factory is divided further into several different risks according to the nature of the work performed by the various departments or groups of men.

A compulsory compensation act to be at all fair must, therefore, grade the risks according to the nature of the business. A company like ours, that has had but three or four serious accidents in 36 years, should not pay into the fund anything like the same percentage of our pay roll as a company located in this city that had 1600 accidents in 1909.

Prevention Better Than Cure

It goes without saying that the prevention of accidents is better than paying for them when they occur. Therefore, the premiums paid should be on a sliding scale and the amount which each individual factory should pay into the fund should be based on the amount drawn from the fund for accidents in that factory, thus making it an object for every employer to constantly improve his risk.

The amounts paid for accidents should also be graded according to the seriousness of the injury received and the length of time the man is forced to be idle. If disabled, the extent of the permanent disability, whether left hand, right hand, one foot, two feet, one eye or both eyes, etc., etc. and to prevent a disabled man from drinking or squandering the money paid him from the benefit, it should be paid in small amounts extending over a series of years, but the weekly or monthly payments should never be less than half pay for the week or month.

In case of death the amount paid to the heirs or beneficiaries should be in the form of an annuity. The amount paid for any accident should never be large enough to tempt workmen to voluntary injury.

The tax (for it is a tax) on the manufacturer should not be large enough to place him at a disadvantage with his competitiors in other States that may not have a similar act.

The fund should be paid into the State treasury. A commission of at least three men should be appointed to collect and disburse it. They should keep all records pertaining to it and appoint examining physicians to certify to, and classify injuries, according to the amounts payable for them. The commission or their appointees should examine and regulate those factories whose business is by nature injurious to health, such as white lead, chemical manufactures, etc.

All acts of the legislature and all special laws now on the statute books should be repealed.

Every injured man should have the privilege of taking his award under the compensation act, or the common law, but not both. If he decides to bring suit under the common law and the award of the jury is not satisfactory he should not be allowed to come in under the compensation act, and the plan should also act *vice versa*.

In my judgment an act compelling the individual manufacturer to pay a specified amount for each and every kind of accident that may occur in his works, whether through the fault of the employee, or the fellow servant of the employee, or through no one's fault, but due to the risks of that particular kind of business, is unwise, unfair and unconstitutional. Under such an act the manufacturer could never tell the cost of doing business, the insurance feature being entirely eliminated.

The ideal solution of the question would be an act of the Federal Government, taxing *all* employers of labor, and all working people, and the establishment of a National Accident Insurance Bureau, the expense of maintaining and operating the bureau to be borne by the Government.

Maintaining Machine Tool Output

By C. K. Lassiter *

Extract of a paper read before the National Machine Tool Builders' Association, showing the methods by which the American Locomotive Company looks after the output of machine tools in its various plants.

*Mechanical superintendent of American Locomotive Company.

A few years ago the American Locomotive Company assigned to me the duties of caring for and maintaining all of the equipment in their several plants, with an object of bringing their equipment up to the highest standard of efficiency, which would tend to increase the production at the least possible cost of maintenance.

A great number of the machines which we had installed in our plants were of obsolete and complicated design, operated by inexperienced workmen and the growing use of modern high-speed steel had a tendency to show a very high maintenance cost when operating the machines.

The first step which I took was to create an organization, for the purpose of caring for and looking after the equipment, and to issue general instructions to all of our managers covering the whole scheme, which was worked out in detail.

In creating this organization the first thing to do was to divide the work into different classes and departments and appoint a local head for each class of work, and have a general head in charge of all the local heads in all of the plants.

The man who was to look after the maintaining of the equipment was given the title of general engineer of maintenance.

He, in turn, had a local engineer of maintenance, whose duties were to look after the maintaining of all equipment, such as machinery, buildings, grounds, tracks and rolling stock.

The idea was to have a system of repairs and records and an accurate distribution of all labor and material applied to maintenance and a systematic report record and method of following up machine failures.

Engineer of Power

We also have a general engineer of power, who has a local engineer of power in each plant, who looks after the power matters such as the production, purchase and distribution of power, heat, light and water; fire protective equipment, watchmen and gatemen.

He also has charge of the engineers for operating pumps, engines, generators, motors, switchboards, heating systems and light; traveling crane operators, firemen, coal handlers, flue blowers and boiler washers.

We have a general small tool supervisor who has a local small tool supervisor at each plant, whose duties are to look after everything pertaining to small tools, such as taps, reamers, twist drills, milling cutters, tool steel, manufacturing tool room and the production and upkeep of all small tools.

The general engineer of maintenance, general engineer of power and general small tool supervisor are located in the office of the mechanical superintendent.

Mechanical Superintendent

The local engineer of maintenance, local engineer of power and local small tool supervisor report jointly to the mechanical superintendent and the managers of the plants, and are the local representatives of the mechanical superintendent.

In addition to the engineer of maintenance I have, at each plant, an inspector of equipment, whose duties are—

(*a*) Investigate and report all condi-

tions which might tend to cause machine failures, and accidents to employees. (*b*) Report abuse of equipment by operators. (*c*) Report equipment not kept clean and in order by operators. Equipment to be cared for by the inspector includes:

(*a*) Machine tools. (*b*) Power equipment. (*c*) Pipes and sewers. (*d*) Builders and structures. (*e*) Rolling stock (locomotives, cars and locomotive cranes). (*f*) Traveling and jib cranes. (*g*) Elevators. (*h*) Swing bridges. (*i*) Chain and lifting slings, etc.

Maintenance Reports

There is a little form issued for every machine-tool failure in each of our plants. Copy of this form is sent daily to the mechanical superintendent's office, which shows the time the machine failed, the cause of the failure and the estimated cost to repair the failure.

At the close of each week we get a report from the engineer of maintenance, showing all of the completed tool-failure orders, actual cost of same and the length of time the machine was out of service due to the failure.

These reports are posted up on an individual machine-tool record weekly, which gives us a perpetual diary of what happens to any machine in any of our plants.

The weekly reports which are sent in to us from the engineer of maintenance classifies these failures under four heads, as follows:

(1) Failures due to Negligence, (2) Improper Design, (3) Accident, (4) Ordinary Wear.

The failures which are shown due to negligence, we take up with the managers with an idea of having the men look after the machines or be laid off.

Failures due to accident, we investigate and see if it is not possible to reduce the number of accidents to the minimum.

Failures due to improper design, we take up and redesign and strengthen the weak parts.

Failures due to ordinary wear, we are continually making investigations to see if it is not possible to simplify the construction of the machines and reduce the number of parts to the minimum, which would in turn have a tendency to reduce this account.

Cost of Manufacturing with Output

The system which I have outlined was installed in 1907. When we installed this system we tried to devise some scheme of having a measuring stick for measuring the cost of our maintenance with the output of our plants and I finally adopted an allowance of dollars and cents per locomotive ton output.

Let me give you an example of the results which were obtained. Before me is a chart showing maintenance-cost curves of all works monthly.

It may be read from this chart that our costs of maintenance have constantly decreased since the installation of this system in July, 1908. The cost for the past year has been about equal to the allowance which we placed on maintenance. The present cost of maintenance is about one-third of the figure which we had to pay for maintenance at the commencement of this system. The saving effected by all of our plants for a single month's business reads in hundreds of thousands of dollars.

At the same time we showed the saving to this extent, we also reduced the productive machine hours which were lost, due to failures, from 12 per cent. to 1¾ per cent.

To illustrate just what this means to this company; In round figures, we have about 9000 machines in all of our plants. When the system was first installed, about 1000 of these were out of service all of the time on account of repairs. The figure now stands an average of 100 machines out of service for this reason.

Test No.	Drill Size.	R.P.M.	Cutting Speed Feet per Minute.	Feed per Revolution.	Inches Drilled per Minute.	Volts.	Amperes.	Horsepower.
1	1″	180	47	0.02	3.75	218	16	4.75
2	1″	337	85	0.022	7	207	31	8
3	1″	338	85	0.022	7.4	205	33	8
4	1″	313	82	0.022	7	204	24	6.5
5	1¼″	210	70	0.02	4.2	207	27	7.2
6	1¼″	285	112	0.0184	5.25	202	40	10.6
7	1¼″	190	62	0.024	4.5	212	24	6.8
8	1¼″	246	81	0.017	4.25	207	27	7.5
9	1¼″	288	95	0.0171	4.95	202	38	10.5
10	1¼″	153	50	0.0216	3.3	210	18	5
11	1¼″	176	58	0.0216	3.8	210	20	5
12	1¼″	193	63	0.023	4.45	206	27	7.5
13	1¼″	218	72	0.017	3.75	208	22	6
14	1¼″	282	92	0.0188	5.3	205	31	8.5
15	1¼″	305	100	0.014	4.45	204	30	8.5
16	1¼″	300	98	0.0188	5.65	202	35	9.5
17	1¼″	300	98	0.017	5.1	202	34	9.5
18	1¼″	304	100	0.016	5.1	205	32	8.8
19	1¼″	290	95	0.018	5.45	202	38	10
Frictional Load of Machine Idle, Including Motor.								
1	0	159	0	0	0	216	2.5	0.7
2	0	186	0	0	0	217	2.6	0.8
3	0	212	0	0	0	217	2.6	0.8
4	0	234	0	0	0	217	2.8	0.8
5	0	333	0	0	0	216	3.6	1

DRILL TEST OF HYDRAULIC-PNEUMATIC DRILL.

How Results Were Effected

In one of our shops, by referring to our reports, we found that 40 per cent. of the failures were due to negligence. We were able to reduce this item to 1¼ per cent.

In another case we found that we were purchasing a certain machine from some of the machine-tool builders, and there was an error in design, which had existed for ten years on this machine, which was costing us something like $5000 per year. We took the matter up with the machine-tool builder and had the design changed, and this was eliminated.

We found that the maintenance on some machines which we had in service was so heavy that we could not afford to keep the machines in service and we replaced them with modern tools. This also showed a decrease in maintenance.

Design of Tools

Most of the tools which we purchase for our works at present are built to specifications prepared by ourselves and it is our aim to cut out every gear or moving part on all machines which are not actually needed for our class of work.

In specifying for planers we require only one speed, as our work is so extensive that we can afford to put a planer on one class of work and never change it.

On vertical milling machines we have specified the design so as to have but one pair of gears between the motor and the cutting tool.

On large vertical boring mills we have cut out gear boxes and equipped the drive with a big plain pulley and placed a variable-speed motor on the ceiling, where the countershaft had formerly been put.

On radial drills we have lowered the speed of the driving shafts and increased the diameter of same, to reduce the maintenance on bearings.

While we have been working on the reduction of our maintenance cost, we have also been looking after the economical use of power in operating these machines.

We have also prepared an allowance for the various kinds of power used throughout our plants, on the same principle as we do for the maintenance.

As an example: In testing out some of our machines we found that there was a considerable amount of power used for removing a certain amount of stock. A good deal of this power we found was absorbed through the friction of unnecessary gears. This is one reason why we have tried to cut out every gear possible on all of the machines which we purchase. It not only saves maintenance but also cost of power to operate machines.

We have recently designed some radial drills upon which we are able to do away with all except one pair of gears.

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American Machinist

Editorial

Speculative Ordering of Material

The speculative ordering of material is to be condemned. We do not refer to merchantable stock, as bar steel of standard grade and size, or pig iron or copper, that is material that is always marketable, but to material that is special, although constituting a raw material for the machine shop, as drop forgings, steel and cast-iron castings and finished or semi-finished parts of whatever kind that are purchased and are not of a commercial nature.

A striking instance of what this may lead to has recently come to our attention. A firm that started in business something over a year ago was steered by a typical inventor. As a result orders aggregating many hundred thousand pieces were placed, some of them being for expensive drop forgings, others for pressed steel parts and special screw-machine work. All of this came from a roseate dream of enormous sales. Without commenting upon the business side of the proposition, the manufacturing side was so poorly worked out that the device has undergone several changes and modifications since these orders were placed, with the result that some modifications were to use the material that had been ordered, and others turned thousands of parts into junk with hardly any salvage value to offset their cost.

It is impossible always to estimate correctly in regard to the number of pieces of a given mechanism that will be required during a given period. However, ordinary business prudence should restrain anyone from ordering hundreds of thousands of pieces until the design is firmly fixed. Such ordering can be characterized by no word short of speculation, and insofar as it is speculation it deserves to be condemned.

For the purchaser it means a direct money loss, for the parts are useless after having been received. For the producer it means unpleasantness, if not loss, for efforts are often made to cancel such contracts after it is recognized that the parts will be of no service. If this is not done, the feeling between seller and purchaser cannot be the most cordial because one has produced, even thought blamelessly, that which is of no value to the other. From every economic standpoint such business is to be deplored.

Do not speculate in orders for special material.

Safeguarding Machinery

Although industrial accidents are still all too frequent, there has been a marked tendency toward safeguarding machinery of all kinds within the past few years. One does not have to be very old to recall the time when every lathe in the shop had all its gearings as fully exposed as the design would permit and the same state of unguardedness applied to every other machine in the shop.

At the present time unguarded gears are hardly to be found on any type of machine tool, a concrete illustration being given in the article on this subject in a recent issue.

The deadly set screw with its projecting head still exists in all too many cases, but is being displaced in many shops and is under the ban of all laws relating to this important subject. We have, however, usually considered plain shafting as being particularly safe, in spite of the fact that a belt which has run off its pulley occasionally becomes tightly wrapped on the shaft and either tears itself in two or pulls down some of the overhead machinery. In the same way clothing occasionally becomes tightly wrapped on the shaft, even where there is no set screw, and the results are too often fatal or productive of distressing injuries.

The laws in some States are now requiring that shafting as well as gearing and belting, shall be perfectly guarded, which brings another problem to every manufacturer. This will, however, be solved in a similar manner to that by which machine-tool gears are being safeguarded, when its need is thoroughly recognized.

When the cost of training skilled workmen is considered, it becomes evident that either injury or death is an economic loss, no matter how the burden may be distributed.

Inventors' Guild

From time to time we have published many articles and editorials, pointing out the need of patent reform. These have invariably been well received by our

readers, and we know that it will be with a certain degree of satisfaction that we announce on another page the formation of a new organization, with headquarters in New York City, known as the Inventors' Guild.

Among the organizers are the names of many of the best known inventors of the United States. The purpose of the guild is to study patent situation and procedure through special agents and investigators in connection with legal authorities, and shape a plan of action to bring about patent reform. One of the first things to be taken up is agitation for a new Patent Office building to replace the old-fashioned stone structure now in use, and which is far inadequate for the tremendous business conducted by the Patent Office. Beyond all this will be action to remedy the delays and ineffectiveness of the Office itself, the expense and tardiness of patent litigation, and the injustice which rich opponents can do to poor inventors through delaying and prolonging suits, thereby increasing legal expenses to a point which practically makes such suits prohibitive in the case of private individuals.

We welcome the formation of this guild, as we welcome any movement which seriously proposes to improve our patent situation. The need is far greater than merely to benefit and procure a greater measure of justice for inventors. It affects directly the entire structure of American industry, and as time goes on it will become more and more necessary to offer every possible aid and to remove every possible barrier which, on the one hand will stimulate, and on the other hinder the growth and expansion of American industry.

We trust that the Inventors' Guild will have a useful, vigorous life and be instrumental in bringing about the enactment of new legislation and instituting these reforms for which we have been working for several years.

National Machine Tool Builders Report

Once more Secretary Hildreth, of the National Machine Tool Builders' Association, has made a record for himself and his organization by getting out the proceedings of the convention long before they had become ancient history, as is often the case in publishing convention reports.

Without resorting to the slide rule, or even considering the fourth dimension, we make it just 45 days between the close of the convention and the appearance of the report. We would suggest that other associations see if it is not possible to find out how Mr. Hildreth does it, as the results are certainly most desirable from every point of view.

New Publications

"Cours de Mécanique," Revised in conformity with the new programs of the National Schools of Arts and Trades. By L. Guillot. Professor of Mechanics at the National School of Arts and Trades and at the Regional School of Beaux-Arts. Volume 1, 428 6x8½-inch pages with 280 illustrations. Librarie Polytechnique, Ch. Beranger, Publisher, 15 Rue des Saint Pères.

This volume is a treatise on theoretical mechanics, using the higher mathematics. It covers the general principles and theorems of graphical mechanical statics, under four heads, namely, the laws of a "material point," those of "material systems," of "passive resistances" and the rules of "graphical statics" proper, following which about one-third of the book is devoted to the resistance of materials. Portions of the book are directly pertinent to machine design, for instance, in the first part, discussions of rolling and other friction, and of clutches; while under "resistance of materials" the author takes up the strength of various machine parts, such as engine frames, piston rods, crank shafts, gear teeth, hooks and chains. Riveted joints are also specially treated. As a general mechanical text book M. Guillot's work makes a pleasing impression.

"Guide de l'Ajusteur." By Jules Merlot, mechanical engineer, in charge of the course of shop technology and director of the machine shops at the University of Liege. Second edition. 360 6x9¼-inch pages with 570 illustrations. Librarie Polytechnique, Ch. Beranger, publisher, 15 rue des Saints-Pères, Paris.

Interest attaches to this work from the fact that its author is in charge of the shops at that Belgian University where Dwelshauvers Dery installed his pioneer steam-engineering laboratory and conducted his famous researches. It is called literally a guide for the "adjuster," which may best be rendered by "fitter," with the understanding that it chiefly relates to the use of bench tools. The term "erector," otherwise perhaps preferable, must be avoided here since the operations in this province are, we understand, explained in another book, called the "Guide du Monteur." The author expressly disclaims a purpose to make the work before us other than elementary and it is therefore occupied with the selection and use of the ordinary types of hand tools, among which, besides chisels, files, drills and the like, gages, calipers and other measuring instruments are discussed at some length. The subject is divided in the following order: Laying out, chiseling, measuring instruments, filing, scraping and polishing, fitting, drilling, reaming, threading, hammering. Gage and thread tables complete the book.

Personals*

Harvey D. Williams, formerly ordnance engineer in the Navy Department, has resigned and for the present is established in Newport, Rhode Island.

J. F. Beecher, formerly holding a position with the Pennsylvania Steel Company as draftsman, has become connected with the Indiana Steel Company, Gary, Ind., and will act as a checker.

Ernest L. Smith, formerly sales manager for the Grant-Lees Machine Company, Cleveland, Ohio, has become western representative of the R. I. V. Company, with offices in Detroit, Mich.

Henry S. Otto, who was formerly connected with the machinery importing firm of Munro & Co., Paris, France, has been appointed superintendent of the Saurer Motor Trucks Company, Chicago, Ill.

John L. Hadley, until recently superintendent of the Woonsocket (R. I.) plant of the United States Bobbin Company, has accepted a managerial position at the company's Manchester (N. H.) plant.

W. A. Kennedy, instructor in mechanical drawing in Brown University, has recently accepted the position of testing engineer with the General Fire Extinguisher Company, of Providence, Rhode Island.

R. F. Greenfield, superintendent of the manganese foundry of the Taylor Iron and Steel Company, of High Bridge, N. J., has resigned to accept a position with the American Brake Shoe and Foundry Company, of Chicago, Ill.

Frederick Exton, who has been connected with the engineering department of the Taylor Iron and Steel Company, of High Bridge, N. J., since 1891, has resigned to accept the superintendency of the Atha Tool Company, of Newark, N. J.

J. R. Phillips, who has been connected with the Pease Foundry, New Toronto, Can., in various capacities, was recently presented with a diamond stick pin by his employers as a token of esteem in honor of the completion of 20 years' service.

R. M. Hvid, until recently connected with the Minneapolis Steel and Machinery Company, is now associated with the Advance Thresher Company, Battle Creek, Mich., acting in the capacity of engineer in charge of construction.

Charles M. Ams, president of the Max Ams Machine Company, Mount Vernon, N. Y., has returned from a very successful three months' trip in Europe and the Continent, during which he established several branch houses and inspected the new Ams factory at Turin, Italy, recently completed.

*Items for this column are solicited.

New Tools and Shop Appliances

A Ferracute External Notching Press

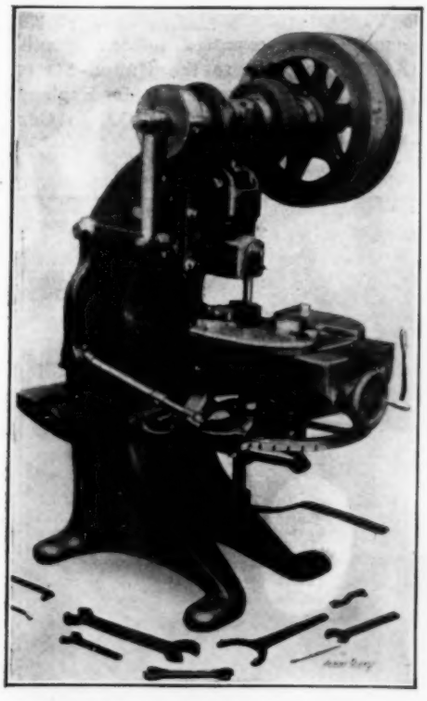
The halftone shows a type C 82 press built by the Ferracute Machine Company, Bridgeton, N. J. This press is intended for cutting the notches on the circumferences of armature disks. It is so constructed that it is capable of turning out accurate work at very high speed.

Clutch troubles incident to high speeds are eliminated by running the shaft continuously and connecting it to the ram through a pitman and a ram clutch.

The indexing is performed by the direct action of a pawl upon a ratchet, which consists of a light tool-steel ring clamped to a spider firmly secured upon the main spindle. This spindle is of large diameter with adjustable double cone bearings, that all looseness may be avoided. The notches can be accurately

ANY and all new or improved machines, tools, or shop appliances of interest to men responsible for results in machinery-making plants will be briefly illustrated and described here—the machine shop news.

A more full and detailed description will be given—when it is real news—if it can appear here first—before it is sent to other papers. All descriptions appear in ALL four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.



A FERRACUTE EXTERNAL-NOTCHING PRESS

located (with reference to any keyseat, holes or other driving apertures in the disk) by means of an adjustable jaw on the lock, which controls the stopping position.

After one revolution of the disk the ram stops automatically at the top of its stroke, while at the same time the pawl is thrown out of mesh with the ratchet. A timing device working upon the hub of the flywheel prevents the machine from starting at the wrong time, so that no care is necessary on the part of the operator as to when he depresses the treadle.

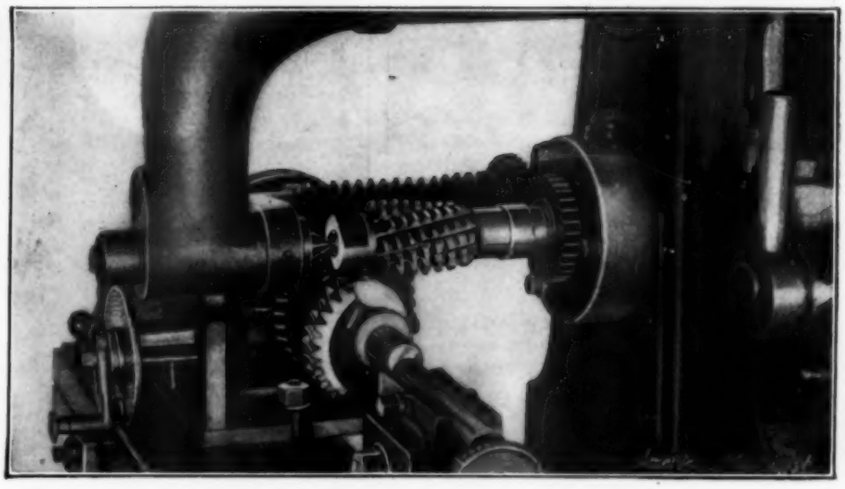
The press is adapted for notching disks from 2 to 24 inches in diameter. Medium-sized work, having about 20 or more notches, may be performed at the rate of 400 strokes per minute, while large work with very few notches may sometimes run as slow as 200 or 300—especially if gang dies are used, cutting two or more notches at once. For any certain number of cuts in a disk, or a multiple thereof, a ratchet must be provided, the maximum teeth being about 140.

Some of the dimensions of the machine are as follows: Hight bed to ram block, when up, 5½ inches; stroke of ram, ¾ inch; adjustment of ram block down, 1½ inches; throat, from ram center back, 9 inches; extreme width, about 33 inches; depth, extreme about 48 inches; hight extreme, about 60 inches; flywheel, 20x3 inches; flywheel weight, about 175 pounds; pressure of ram, about 7 tons; weight, about 1400 pounds.

Garvin Worm Hobbing Attachment

The halftone shows a hobbing attachment, built by the Garvin Machine Company, New York, as applied to one of their milling machines. It is shown at work hobbing worm sectors.

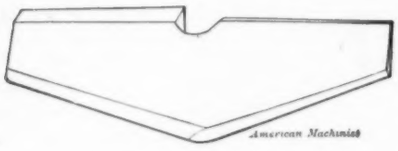
The tapered hob is mounted in the spindle of the machine geared to it and running at the same speed is a long worm the same pitch as the hob. This worm engages a worm wheel of the same pitch diameter as the sector to be cut. The worm wheel and sector are mounted, between centers, on the same mandrel. The operation is as follows: The table of the milling machine is run in close to the column. A blank segment is put on the mandrel, the machine started and the automatic cross feed thrown in. The tapered hob enters the work gradually, and by the time the table reaches the position shown, the work is finished.



GARVIN WORM-WHEEL HOBBING ATTACHMENT

Bath Universal Slip

The stone illustrated here is the latest addition to the India oilstone line placed on the market by the Norton Grinding Company, Worcester, Mass. The great variety of practical sharpening faces make it adapted to sharpening all styles of cutting tools. It can be applied to any shape of tool and the cutting edges can



BATH UNIVERSAL SLIP

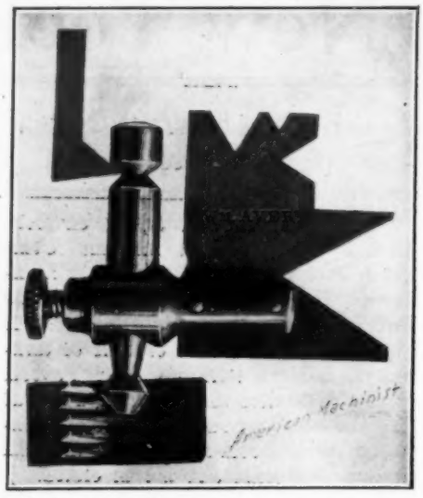
be sharpened with natural ease and accuracy. When held in the hand it balances perfectly to the angle of the cutting edge of tool, and no matter which face is being used the shape of the stone is such that it can be held comfortably in the hand.

A Boring, Drilling, Milling and Tapping Head

The halftones show a standard 7-foot boring mill, built by J. Morton Poole Company, Wilmington, Del., equipped with their new type C boring head. This head is designed to use milling cutters up to 12 inches diameter cutting in horizontal or vertical directions. The spindle is 6 3/16 inches diameter and has a stroke of 16 inches. The saddle has a bearing of 28⅜ inches on the cross rail. The drive is either by 5-horsepower variable-speed reversing motor or by two-speed countershaft and three-step cone pulley together with two mechanical speed changes. There are 12 spindle speeds ranging from 8 to 96 revolutions per minute in geometrical progression; four boring feeds from 1/64 to ⅛ inch per turn of spindle; four milling feeds from 1/80 to 1/10 inch per turn of spindle; eight horizontal cutting feeds from 1/40 to 1 inch, and 14 vertical cutting feeds from 4/9 to 1/720 inch. This head has the same number of feeds for both facing and turning as the standard head.

An Inside Thread Tool Setter and Gage

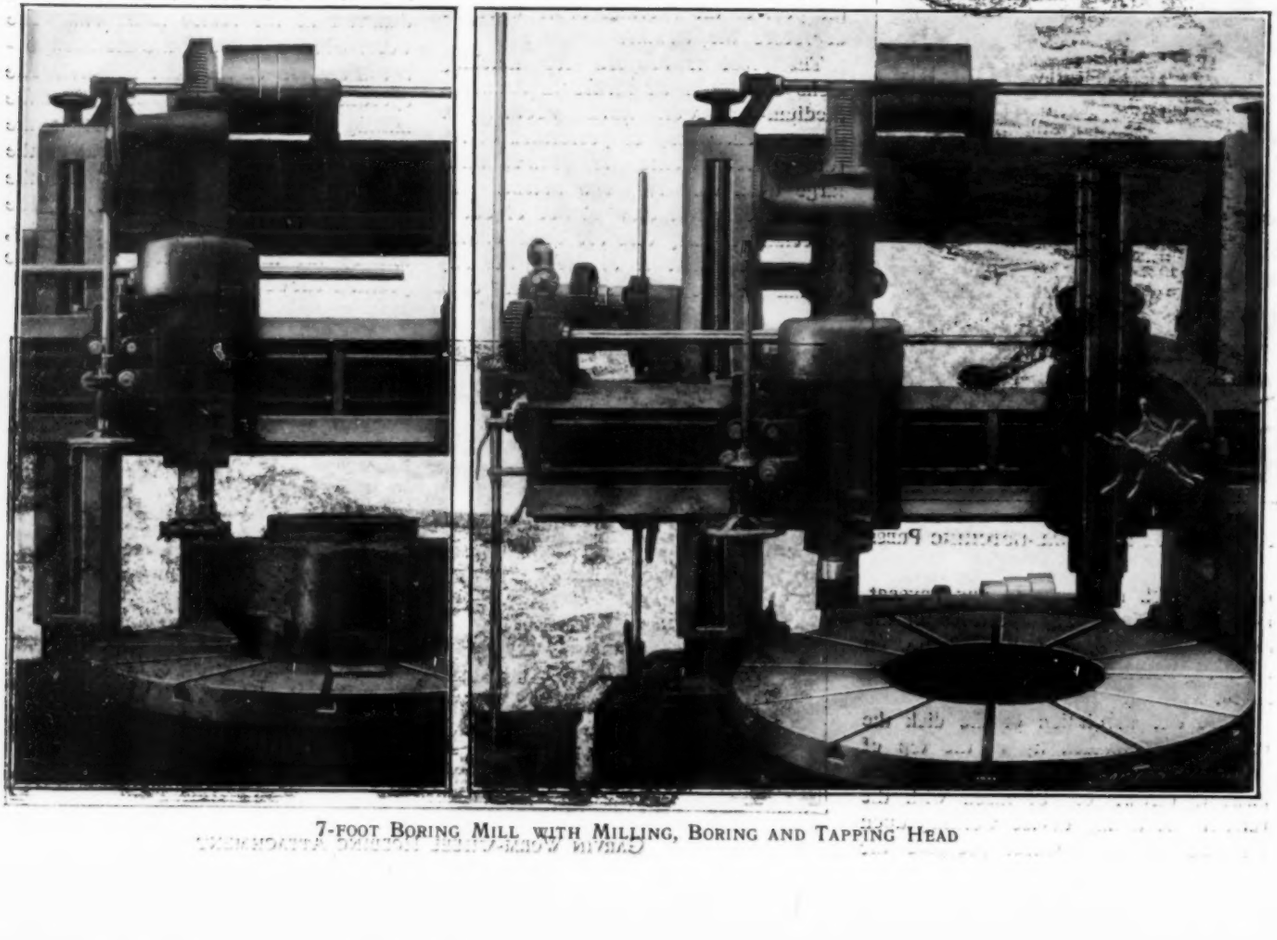
The halftone shows a simple little tool which enables one to reset the inside U. S. S. V., Acme or square threading tool correctly after it has been reground. One end has a male V which engages the partly finished internal thread; exactly one inch from this a female V is turned in the rod. With the male V meshing with the internal thread the tool is set to the female V, with the assurance that it will catch the thread correctly, providing the thread is not fractional. Besides the setting device for internal threading the tool



INSIDE THREAD-TOOL SETTER AND CENTER GAGE

has the usual thread gage. It is made by William Avery & Co., Foxboro, Mass.

According to a consular report, the export of iron ore from Lulea, Sweden, during the month of September amounted to 272,000 tons. This is the largest quantity ever exported in one month; 13,000 tons went to the United States, 11,500 to Belgium, 42,000 to England, 61,700 to Holland, and 143,000 to Germany.



7-FOOT BORING MILL WITH MILLING, BORING AND TAPPING HEAD

Economics of Industrial Education*

By T. N. Carver†

A convincing explanation of fundamental facts on which rests the possibility of social and industrial development through education.

*A paper read at the Boston convention of the National Society for the Promotion of Industrial Education.

†Professor of political economy, Harvard University.

In the present conservation movement it is highly important that we realize two things: First, that our most valuable resources are our people, and second, that we are wasting people more than we are wasting anything else. If we forget either of these things we shall probably find ourselves trying to save at the spigot while we are wasting at the bunghole.

Illustrations of a Law

That our most valuable resources are our people may be inferred from certain large facts of economics. Communities have grown rich in the midst of poor geographical surroundings by reason of the simple fact that they have developed the latent energy of their people and applied this energy intelligently. Scotland and New England are conspicuous examples of this kind. These communities have, in the past at any rate, developed their human resources and directed them more intelligently than most other communities. Modern Germany may also be mentioned because, though not poor in geographical resources, it has only been since she began training her producers in a superior way that she has risen to preëminence as an industrial nation. Other nations have grown poor in the midst of rich geographical resources by reason of the simple fact that they have wasted their people, not simply in war, but by allowing their latent energy to remain undeveloped, or to be unintelligently utilized. Ireland, Spain, and Southern Italy are conspicuous examples of this kind of waste. Speaking generally, one is safe in saying that no nation ever did prosper as compared with other nations except by reason of its superior conservation of the human factor in production. In view of these large facts it is reasonably safe to say that the most destructive form of waste is the waste of labor-power.

Ways in Which Labor Power Is Wasted

If one will look carefully about he will see in any community so many ways in which labor-power is being wasted as to convince him that here is the greatest of all forms of national waste, though it is much greater in some communities, than in others. One will find, for example, four characteristic forms of waste labor-power, all of them of considerable magnitude. There is, first, the army of the unemployed or the involuntarily idle; second, the imperfectly employed, or the untrained; third, the improperly employed, or the acquisitively rather than productively employed; and fourth, the voluntarily idle, commonly known as the leisure class.

Of these four forms of waste labor-power that which goes under the name of the unemployed or the involuntarily idle is, fundamentally, the least important of all. It is the least important, first, because it is, generally speaking, the less efficient rather than the more efficient which goes thus unemployed; second, because the elimination of the other forms of waste labor would go a long way toward bringing this army of the unemployed into employment. The reasons for this conclusion are as follows: The chief reason for this unemployment is the fact that there are more of certain types of laborers than can be economically combined with the existing supply of other kinds of labor. It takes, for example, sulphur, saltpeter, and charcoal, in certain rather definite proportions to make gunpowder. If circumstances should arise under which there was more charcoal than could be combined with the existing supply of saltpeter and sulphur, some of the charcoal would of necessity remain unused, assuming, for the sake of illustration, that there is no other use for it. Even though there might be a considerable demand for gunpowder, this surplus charcoal would remain unused and unbought for the simple reason that there was not enough saltpeter or sulphur to combine with it. This would look like an anomaly to some people who would not be able to see any reason why charcoal should remain a drug on the market when there was such a lively demand for gunpowder, and some of them would probably attribute it to the machinations of the evil one. But it would not be an anomaly at all; but a plain, logical result of a disproportionate supply of the ingredients, which enter into the product for which there was a demand.

Similarly, it takes a good many different kinds of labor to carry on our industries, and they need to be combined in certain somewhat variable though fairly definite proportions. If there happens to be more of a certain type of labor than can be economically combined with the existing supply of the others, then a part of the one type must remain unused or unemployed. Even though there might be a very lively demand for the products of industry it would not bring this type of labor into employment unless more of the other types of labor could be found to combine with it. It seems anomalous to some people that this type of labor should remain unemployed while there is such a lively demand for the product into whose production it enters as one of the factors. Some of these attribute this result to the machinations of the evil one; others substitute the name of "capitalism" for that of the evil one and attribute all such results to its malign influence. But really it is not an anomaly at all, but the plain logical result of the physical rather than governmental fact of a disproportionate supply of the factors which have to be combined in production. For these reasons, we conclude that one very effective remedy for unemployment is to bring about a less disproportion among the factors of production. This can be done by eliminating the second of the above named kinds of waste labor.

Redistribution of Labor Power Upward

The second kind of waste labor-power, namely the imperfectly employed, includes all those who are doing less skilled work than they might be doing if they had only had adequate training. They are, for example, the men who are doing unskilled manual work who might be doing skilled manual work, or doing skilled manual work when they might be doing the more highly skilled, the scarcer, and more needed work of management, or who are doing routine, salaried managerial work when they might be doing the still more skilled, the still scarcer, and the still more needed work of initiating and organizing new productive enterprises. Upon the redistribution of labor-power upward from the unskilled and overcrowded occupations toward and into the skilled, undercrowded, and highly remunerative occupations, depends more than upon anything else, the expansion of our industries. That would be like transforming the overabundant charcoal, of the above illustration, into the underabundant saltpeter or sulphur. In this case, however, it takes no miracle, but only sound education, to work the transformation or the redistribution. Such an expansion would incidentally go a long way toward solving the problem of the unemployed. It is important, however, that the redistribution of men should be carried on all the way up. It should result in the multiplication of the number of independent business men, as well as of skilled manual workers, if the full benefits are to be secured.

The Scarcest Grade of Labor

As a chain is only as strong as its weakest link, so an industry can expand only as far as the scarcest factor in that industry will permit. In every industry and in every community the scarcest factor is always independent managing ability. The next is skilled manual labor, while the most abundant of all is unskilled, nondescript labor-power. If anyone doubts this, let him start out to hunt first for an unskilled worker, who wants a job, second, for a skilled worked who wants a job, and third, for a competent manager who wants a job, and let him then report as to which he had the least trouble, and which the most trouble finding. If he finds that, in the unskilled trades there appear to be a good many more men than jobs, in the highly skilled trades not so many more men than jobs, and fewer men capable of initiating and managing successful enterprises than are actually needed to employ the labor and supply the demand for goods, then the proposition is demonstrated that the last named is the scarcest, and the first named is the most abundant factor of production. If this position be correct, then there would be very little use in adding to the number of unskilled laborers. Since there are already about as many as can be used in combination with the other factors of production, it would make very little difference in the total output to add a few more to this class. It would be like adding to the already overabundant supply of charcoal in the above illustration. But it would make a great deal of difference if you were to add a few thoroughly competent business managers, capable of starting new and successful business enterprises. That would be like adding to the scarce supply of sulphur or saltpeter in the above illustration.

A Better Distribution of Wealth

Such a redistribution of men among the different occupations would not only expand the industries of the country, and increase the amount of wealth produced, but it would also bring about a less unequal distribution of the wealth. When there are more men in one group of occupations than can be economically employed in combination with the existing supply in other groups, there will invariably and inevitably be low wages in the one group. Conversely, when there are too few in another group of occupations than can be economically combined with the existing supply of other kinds of labor, there will invariably be high wages, salaries or profits in this group. The most effective and rational method, therefore, of redistributing wealth is to redistribute men, making them scarcer where they are now superabundant, and more abundant where they are now scarce. I am not delegated to speak for other economists but for myself, I should take very little interest in any scheme of education which did not bring about such a result; which did not, in fact, make unskilled laborers scarcer and harder to find, and employers more abundant and easier to find than they are now. Such a policy would not only distribute wealth more equally, but would in addition, increase the sum total of wealth to be distributed.

It used to be said that the man who made two blades of grass to grow where one had grown before was doing more for the world than all the politicians put together. It is now time to say that he who makes two men of rare and much-needed ability exist where one had existed before, is doing more for the world than all the politicians and radical social reformers put together. This is precisely what is involved in the elimination of waste labor-power at the upper end of the social scale, where labor-power is scarce. Particularly is this true of the elimination of the form of waste labor-power known as the imperfectly employed. This is the special work of industrial education. The elimination of the other forms of waste labor does not properly come within the field of industrial education, and need not be discussed here.

Increasing Shop Capacities

Metal Working

News items for the sales department—where more equipment will be needed. Authentic news is solicited for this department, not rumors or gossip—facts.

NEW ENGLAND

Reed & Barton, silversmiths, are constructing an addition to their plant in Taunton, Mass.

V. H. Blackington & Co., Attleboro Falls, Mass., will erect a two-story addition to their jewelry factory.

The brass foundry of the Textile Finishing Machinery Company, Providence, R. I., was badly damaged by fire.

The Oven Equipment and Manufacturing Company, of Stamford, Conn., will erect a factory in Hamden, Conn.

The Collin Valve Company, Portland, Me., has been organized with $100,000 capital. William A. Cullenan, president.

The Springfield (Mass.) Power Associates are to erect a two-story commercial garage. Modern equipment will be required.

The T. E. Bennett Company, Providence, R. I., jewelry manufacturer, has taken additional floor space and will install new machinery.

The International Rotary Motor Company, Portland, Me., has been organized to manufacture and deal in engines and motors. Capital, $250,000. Wm. Louis Merrill, president.

The Union Cast Steel and Iron Company has applied for a Massachusetts charter and will engage in the manufacture of steel horseshoes, etc. Capital, $100,000. Incorporators are Edward A. Sanford, of Somerville, Mass.; Arnold B. Sanford, New York, etc.

MIDDLE STATES

The Mead Engine Company, Dayton, Ohio, will erect a plant.

The Hartford Suspension Company, Jersey City, N. J., will erect a new factory.

Seward & Crane, Cambridge, Mass., will erect a large garage and repair shop.

Albert S. Jenks, 19 Prospect avenue, Mt. Vernon, N. Y., will build a blacksmith shop.

The Auburn Garage Company, Auburn, Me., will build an addition to be used as a repair shop.

Wm. Gateman, Manitowoc, Wis., will erect a garage and install machine shop for repair work.

The Keeley Stove Company, Columbia, Penn., will erect a four-story addition to its plant.

The Dessault Foundry Company, Lockport, N. Y., is erecting a large addition to its building.

The Trumbell Electric Manufacturing Company, Plainville, Conn., will make extensive additions.

The Detroit (Mich.) Forging Company has awarded contract for the construction of a three-story addition.

The New York Central Railroad is building a six-stall roundhouse in the Salina freight yards, Syracuse, N. Y.

The Elkhart (Ind.) Motor Car Company is looking for site in Oklahoma City, on which to erect a branch plant.

The Bagley & Sewall Company, Watertown, N. Y., building paper machinery, is planning the removal of its plant.

The R. A. Becker Varnish Company, Brighton, Cincinnati, Ohio, is contemplating an addition to its plant.

The S. S. Wenzell Machine Company is to erect a new plant at Fiftieth street and Parkside avenue, Philadelphia, Penn.

The Gamon Meter Company will erect a plant at 280-294 South street, Newark, N. J., for the manufacture of water meters.

The Universal Manufacturing Company, of Racine, Wis., will build a plant to manufacture steering gears and other auto parts.

The New York Shipbuilding Company, 12 Broadway, New York, is said to be considering the erection of a plant in the New England section.

The Simms Magneto Company, 1780 Broadway, New York, is now ready to buy equipment for a new plant being erected at Watsessing, N. J.

The National Supply Company, Toledo, Ohio, will erect a large addition to its plant. The concern will manufacture oil-well and plumbers' supplies.

The Senn Steel Hoe and Tool Company, Egg Harbor, N. J., has been looking in the Southern section for site for a plant to employ about 1500 men.

The B. V. Edwards Company, of Bayonne, N. J., building automatic machinery, is about to equip a new factory at Murray and Austin streets, Newark, N. J.

The Union Iron Works, Decatur, Ill., has acquired more ground and contemplates the erection of two new buildings, including machine shop and foundry.

The Harley-Davidson Motor Company has been granted a permit to erect a $28,000 factory, five stories high, at Thirty-eighth and Chestnut streets, Milwaukee, Wis.

The Ohio Culvert Company, of Middletown, Ohio, has purchased the plant of the Lewis Corrugated Culvert Company, at Elyria, Ohio, and will occupy it in the future.

The Norwalk (Ohio) Drill and Tool Company is negotiating for some buildings at Prospect and Rule streets, and if site is secured, will erect additional buildings.

General Foundry Company, Warren, Ohio, has been incorporated with $100,000 to do a general foundry business. Incorporators, George F. Fellius, Calvin Campbell, William H. Hulme, etc.

The Automatic Appliance Company, of Boston, Mass., has been incorporated for the purpose of manufacturing and dealing in mechanical and electrical machinery. F. H. Whitman is president.

Recording Speedometer Sales Company, East Orange, N. J., has been organized to manufacture recording instruments. Capital, $125,000. Incorporators, H. H. Picking, C. O. Geyer, F. E. Ruggles.

The Ross Manufacturing Company, Brooklyn, N. Y., has been incorporated to manufacture engines, airships, etc. Capital, $50,000. Incorporators, T. H. Ross, H. A. Lessig, A. W. Rusel, Brooklyn.

The Nichols & Wright Motor Company, Buffalo, N. Y., has been incorporated to manufacture motors, engines, etc. Capital, $300,000. Incorporators, W. R. D. McMcQuarrie, C. G. Horning, B. Knox.

Work has been commenced on new buildings, at Schuylkill Haven, Penn., to replace the Reading car shops, destroyed by fire. These will include machine shop, blacksmith shop, carpenter shop, etc.

The Miller & Francis Company, West Orange, N. J., has been incorporated to build locomotives, engines, railway cars, etc. Incorporators, C. E. Miller, West Orange; A. W. Francis, East Orange, etc.

Harry T. Scully has purchased site in the rear of the W. T. Cressler plant, on Lexington avenue, Norwood, Cincinnati, Ohio, and will put up a factory for the manufacture of molders' finishing tools.

Virden Manufacturing Company, Cleveland, Ohio, has been organized with $10,000 to manufacture and sell all kinds of metal articles. E. A. Foote, M. R. Mickey, Jr., E. S. Cook, etc., are incorporators.

The Rochester Can Company, Rochester, N. Y., has bought out the Non-Rust Tinware Company, of that city, and the Can company will, in the near future, enlarge its plant to take care of the additional business.

The Vickers Motor Car Company, Coshocton, Ohio, has been incorporated to manufacture and sell motor vehicles. Incorporators, Eugene H. McMasters, Carl B. Vickers, William C. Myers, etc. Capital, $25,000.

It is reported the American Locomotive Works has plans under consideration for large new shops to be located in the Middle Atlantic section, preferably Pennsylvania. Main offices are at 30 Church street, New York.

The Igon Manufacturing Company, Springfield, Ohio, has been organized with $100,000 to manufacture and deal in all kinds of machinery. Dennis F. Igon, Paul A. Staley, Dale C. Igon, L. Ewing Jones, etc., incorporators.

Holzwarth Hardware Company, Liverpool, N. Y., has been organized to manufacture and deal in hardware, fixtures, etc. Capital, $15,000. Incorporators, Fred Wyker, Arthur H. Wyker, Liverpool; Andrew Holzwarth, Syracuse.

The W. A. Case & Son Manufacturing Company, Buffalo, N. Y., has secured the factory of the Wagner Machine Company, at Perry and Mississippi streets, and will equip same for the manufacture of refrigerating machinery.

The F. & M. Specialty Company, New York, has been incorporated to manufacture self-propelling vehicles, engines, etc. Capital, $50,000. Incorporators, R. V. Fitzgerald, Newark, N. J.; O. S. McFarland, G. Colvin, New York.

Henry Disston & Sons, Inc., have acquired a tract of about 100 acres along the Wissahickon, near Ambler, Penn., for the purpose, it is reported, of the erection of a large manufacturing plant, a branch of the establishment located in Tacony.

The Bates Tractor Company is being organized at Lansing, Mich., with a capital of $200,000, for the purpose of manufacturing a gas traction engine. M. F. Bates, of the Bates & Edmonds Motor Company, is at the head of the new company.

Van Auken Indicator Company, New York, has been incorporated with $16,000 capital to manufacture machinery, tools, etc. Incorporators, Clarence E. Van Auken, 617 West One Hundred and Thirty-fifth street; Geo. Crooke, Jos. A. Shea, 101 Warren street.

The plant of the Webster Manufacturing Company, of Chicago, will be moved to Tiffin, Ohio. The company will erect five factory buildings having a total floor space of 200,000 square feet. Seven hundred men will be employed. The company manufactures power-transmitting, elevating and conveying machinery.

At Toledo, Ohio, negotiations are pending, which, if successfully concluded, will give that city the largest electrical vehicle plant in the country. The plan is to merge the Ohio Electric Car Company and the Milburn Wagon Works. The Milburn company has a capital of $700,000 and is engaged in the manufacture of farm wagons, buggies and motor-car bodies, and the Ohio Electric Car Company has a capital of $150,000.

SOUTHERN STATES

W. L. Alley, Richmond, Va., will erect a blacksmith shop.

The Emerson Engine Company will build a new factory at Alexandria, Va.

The Southern Shovel Manufacturing Company, Gadsden, Ala., is enlarging its plant.

The Southern Pacific Railroad will erect a new roundhouse, repair and machine shops in Lafayette, La.

W. A. Stewart, Corinth, Miss., will establish a plant for the manufacture of metal and wood patterns.

The Roanoke (Va.) Bridge Company has purchased site and will erect at once a modern plant for the building of iron bridges and structural iron.

Daniel L. Chandler, of the Chandler Planer Company, Ayer, Mass., has invented a comb-making machine and is said to be interested in the establishment of a plant for the manufacture of same.

WEST OF THE MISSISSIPPI

The Schurmeier Motor Car Company, St. Paul, Minn., will enlarge its plant in the spring.

Fred Pressel will build a blacksmith shop at Anaheim, Cal. Modern equipment will be installed.

The Pioneer Boiler and Machine Works, Los Angeles, Cal., is building an addition to its plant.

C. S. Wert, Kendallville, Ind., manufacturing cement machinery, will move his plant to South Bend, Ind.

A. W. Calkin, president of the Kansas City (Mo.) Pump Company will establish a gasoline-engine factory.

The El Paso & Southwestern Railroad has purchased property at Phœnix, Ariz., and will erect shops on the site.

Kullman & Bloss, San Diego, Cal., have leased property and will establish an ornamental iron-works shop.

The California Ornamental Iron Works has been incorporated for $25,000 and will operate at Los Angeles, Cal.

Henry Conoli, Monrovia, Cal., is erecting a modern garage and repair shop. Repair equipment will be installed.

The Crawfordsville (Ind.) Wire and Nail Company has awarded contract for the erection of a new tank factory.

The Southern Pacific Railroad will expend about $1,000,000 for new roundhouses and repair shops, at Portland, Ore.

H. Lymann will build a commercial garage and repair shop at Long Beach, Cal. Modern repair machinery will be installed.

W. L. Lynds, Los Angeles, Cal., will build a commercial garage on Locust avenue. Modern repair machinery will be installed.

Auger Brothers Machine Company, Minneapolis, Minn., has moved to 2217 Marshall street, and will make small-boat motors.

Morrow, Loomis & Co., Los Angeles, Cal., will erect a large garage and repair shop on Grand avenue. Modern repair machinery will be installed.

The Weisenborn Manufacturing Company, Denver, Colo., manufacturing plows, is said to be looking for suitable location on which to erect a new plant.

The Gulf, Colorado & Santa Fe Railroad will erect a machine shop and addition to its roundhouse at Somerville, Tex. General offices are in Galveston.

The M. Rumley Company, of La Porte, Ind., will erect a branch plant in Des Moines, Iowa, for manufacturing traction engines, huilers, thrashing machines, etc.

Tennison Brothers, of Texarkana, Ark., will erect a branch factory in Houston, Tex. The concern manufactures eave troughs, metal shingles, stove pipe, etc.

The St. Louis, Bartlesville & Pacific Railway, a new concern, it is said, will establish

shops at Bartlesville, Okla. General offices will also be located there.

The Northwestern Drainage Company, Thief River Falls, Minn., is erecting a plant on West Second street, for the manufacture of heavy dredging machinery.

The Ware Motor Vehicle Company is being formed at St. Paul, Minn., to manufacture motor trucks. Site has been secured on University avenue. J. L. Ware is president.

An automobile-manufacturing plant will be established near Sacramento, Cal., by E. C. Collins and associates, of Sacramento. About $250,000 will be expended on buildings and machinery.

The Thiem Manufacturing Company, making motorcycles and motorcycle parts, is moving from Columbus Heights, Minneapolis, to St. Anthony Park, St. Paul, Minn., where it will have larger quarters and be associated with the Joerns-Thiem Motor Car Company, builders of heavy motor trucks.

GENERAL MANUFACTURING

NEW ENGLAND

D. L. Stone, Haverhill, N. H., will install steam pumps.

Fall River, Mass., will erect a new technical high school.

The O. C. White Company, Worcester, Mass., will install a Corliss engine.

The town of Sterling, Mass., has voted to install a lighting plant.

Cambridge, Vt., is considering the erection of a municipal waterworks.

The town of North Woodstock, N. H., will install a hydroelectric plant.

The Interlaken Mills, Arkwright, R. I., is building an extensive addition.

The Lubec Sardine Company is to erect a $25,000 factory at Belfast, Me.

The Maine Reduction Company, Roxbury, Me., will install a steam boiler.

F. L. Hayden, Cambridge, Mass., is in the market for a small, vertical boiler.

John C. Meyer & Co., Lowell, Mass., will install a new 75-horsepower boiler.

B. F. Holt, Lexington, Mass., is in the market for a small gasolene engine.

B. B. and R. Knight will build an addition to the Grant mill, in Providence, R. I.

The Nashua Coal and Ice Company, Nashua, N. H., requires ice-conveying apparatus.

The Nashua (N. H.) Card and Paper Company is erecting an addition to its plant.

The R. W. Lord Company, West Kennebunk, Me., will erect an addition to its twine plant.

The Providence Braid Company will build a large addition to its plant in Pawtucket, R. I.

The plant of the Pawtucket (R. I.) Cabinet and Builders' Finish Company, was burned.

The plant of the Warren (Mass.) Specialty Manufacturing Company was badly damaged by fire.

The New England Sanitarium, Melrose, Mass., is contemplating the addition of a new engine.

The planing mill of the Arthur S. Allen Company, New Bedford, Mass., was destroyed by explosion.

The J. B. Renton Company, Lynn, Mass., manufacturing heels, etc., will erect a four-story factory.

J. A. Brenner & Co., Bow street, Somerville, Mass., will buy a buzz planer, band saw and saw table.

The Boston (Mass.) Elevated Railroad is to have erected a power house of 60,000 horsepower capacity.

Joseph Benn & Sons, Inc., will install a large steam turbine in their new mill, at Greystone, R. I.

The United States Post Office Department will install a steam boiler at the post office in Ellsworth, Me.

The Holmes Knitting Company, Malden, Mass., will erect a factory for the manufacture of underwear.

The Water Commissioners, of South Hadley, Mass., are in the market for a power pump and oil engine.

A shoddy mill, at Franklin, Mass., owned by City Mills Woolen Company, destroyed by fire, will be rebuilt.

The Rockfall Woolen Company, Middletown, Conn., will erect a two-story addition for the manufacture of blankets.

The Connecticut River Power Company is considering the erection of a dam and power plant at Windsor Locks, Conn.

The Lynn Realty Trust Company, Lynn, Mass., has awarded contract for a laundry building to be occupied by F. C. Cheever.

The New London (Conn.) Ship and Engine Company will erect a new power house in connection with its new machine shop.

The woodworking mill of the Benjamin Chase Company, Derby Village, N. H., destroyed by fire. Loss, $20,000. Will be rebuilt.

The George Lawless & Sons, Inc., yacht builders, will move their business from South Boston, Mass., to their new plant at Neponset, Mass.

The Locks and Canals Company, Lowell, Mass., is interested in a syndicate for the purpose of erecting another textile mill in Lowell, Mass.

Rawitzer Brothers, of Stafford Springs and Meriden, Conn., manufacturers of stockinet and part cotton goods, are planning to locate in Greystone, Conn.

The Ames Plow Company, Worcester, Mass., will erect a power plant in connection with its proposed new factory, at South Framingham, Mass. Electric drive will be used throughout.

MIDDLE STATES

Fire destroyed the cigar-box factory of F. Brechts, Philadelphia, Penn.

Welch Brothers will erect a plant for canning maple syrup at Edwards, N. Y.

The Capital City Plating Works, Albany, N. Y., is planning to enlarge its plant.

The Western Wheel Scraper Company, Aurora, Ill., will erect a new boiler house.

The plant of the Parlor Frame Company, of Plymouth, Wis., was destroyed by fire.

Lewis Max, 52 Greene street, New York, will erect a piano factory in Jersey City, N. J.

Fire destroyed the plant of the York (Penn.) Woodworking Company. Loss, $40,000.

Wm. Simon, 701 Clinton street, Buffalo, N. Y., will erect a $15,000 addition to its brewery.

Fire destroyed the factory of the French Battery Company, Madison, Wis. Loss, $20,000.

The plant of the Standard Leather Company, Pittsburg, Penn., was burned. Loss, $80,000.

Fire destroyed the plant of the L. A. Bellis Carriage Company, Somerville, N. J. Loss, $30,000.

Fire destroyed the printing plant of the Stubbs-Esterling Company, Detroit, Mich. Loss, $50,000.

The National Woolen Company, Cleveland, Ohio, has commenced the erection of a three-story addition.

The Standard Oil Company, 1103 Elk street, Buffalo, N. Y., will build an $11,000 addition to its boiler house.

E. A. Kline & Co., Cleveland, Ohio, a large cigar-manufacturing industry, will move its plant to Buffalo, N. Y.

The plant of the Leisen & Hones Brewing Company, Menominee, Mich., was destroyed by fire. Loss, $200,000.

Fire destroyed the plant of the Endrich Tobacco Company, Evansville, Ind., causing a loss of about $750,000.

The town of Bristol, Penn., will advertise for bids for the erection of a municipal waterworks and sewage system.

The Wagstaffe Company, Ltd., of Hamilton, Ont., proposes to erect a modern fruit-preserving plant at Buffalo, N. Y.

The Osborne Manufacturing Company, Newark, N. J., engravers and printers, will erect a large addition to its plant.

The James R. Hensler Brewing Company, Murray street, Newark, N. J., will install a new engine and ice machines.

The Pittsburgh Wall Paper Company, now located at New Brighton, Penn., will remove its plant to Niagara Falls, N. Y.

The Candee Company, manufacturers of incubators, at Orrville, N. Y., near Syracuse, proposes to double the capacity of its plant.

The Westchester Electric Railway Company, Mount Vernon, N. Y., contemplates building a $200,000 power house in White Plains, N. Y.

The plant of the Knox County Window Glass Company, Mt. Vernon, Ohio, was totally destroyed by fire recently. It will be rebuilt.

The Electrode Company of America has begun the erection of a plant at Niagara Falls, N. Y., where they will manufacture large electrodes.

Secretary of War Dickinson has asked for an appropriation of $154,667 to build an electric power plant on Corregidor Island, in the Philippines.

The Capital Traction Company, Washington, D. C., has commenced the erection of a new power house at Thirty-second and K streets, northwest.

F. N. Burt & Co., manufacturers of paper boxes with three plants in Buffalo, N. Y., will erect a five-story brick addition to their present plant at Hamburg and Myrtle avenues.

An increase in the authorized capital of the Marion Pure Milk Company, of Marion, Ohio, has been made from $10,000 to $25,000 in order to install more machinery in its plant.

Having outgrown its present plant, the Watertown (N. Y.) Consumers Brewing Company will erect a new and modernly equipped brewery on the site of the old establishment.

The United States Gypsum Company, at Oakfield, N. Y., contemplate the erection of a new mill during the coming winter, with a capacity of from 900 to 1000 tons per day.

The Morristown Milk Products Company is erecting a new creamery at Morristown, N. Y., where all kinds of milk products will be manufactured. A plant for drying casein will be installed.

The United States Paper Goods Company, Cincinnati, Ohio, has acquired property at Plum and Pearl streets, that city, on which it will erect a large building for manufacturing purposes.

The Fear-Naught Tire and Rubber Company, Paterson, N. J., has been incorporated to manufacture auto tires, etc. Capital, $125,000. Incorporators, E. J. Forhan, S. F. Martin, H. P. Jones.

The Woerner Canning Company, Liverpool, N. Y., has been incorporated to preserve and

can foods. Capital, $50,000. Incorporators, David C. Woerner, Liverpool; Wm. E. Hopkins, Thos. W. Dixson, Syracuse.

Athens (Ohio) Heat, Light and Power Company has been formed to produce and sell gas and electrical current. Capital, $25,000. Incorporators, F. T. Lindman, C. S. Blauvelt, W. Edison Detlow, etc.

The Western Compound Rubber Company, Cincinnati, Ohio, has been incorporated with $100,000 to manufacture and sell all kinds of rubber articles. Incorporators, Henry W. Jones, John E. Pitts, J. Albert Mauss, etc.

The Mercer Stone Company, Bowling Green, Ohio, has been incorporated with $25,000 to manufacture and sell crushed stone of all kinds. Incorporators, George E. Mercer, A. G. Mercer, Delasus Mercer, B. C. Harding and J. E. Kelly.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids December 27, for 3400 pounds sheet brass (schedule 3179), 30,000 pounds manganese bronze (schedule 3184), 1000 pounds spelter solder, 8500 pounds cold-rolled steel, 24,000 pounds rivet steel, 21,700 pounds galvanized sheet steel (schedule 3180), 75,000 pounds hot-rolled or forged steel (schedule 3176).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids December 20, as follows: Two 1500-watt generator sets (schedule 3185), six chipping hammers, six pneumatic drills (schedule 3178), three water weighers (schedule 3175), 420 brass unions, 84 brass gate valves (schedule 3183), 26,000 feet wrought iron or steel pipe, brass tubing (schedule 3179).

SOUTHERN STATES

The city of Jonesboro, N. C., will construct waterworks.

The Greeneville (Tenn.) Broom factory will move to Bristol, Tenn.

The Acme Box Company, Chattanooga, Tenn., is erecting a new plant.

The Thomasville (Ga.) Ice Company will double the capacity of its plant.

The Martha Washington College, Abingdon, Va., will erect a power house.

It is reported Armour & Co. will erect a cold-storage plant in Greensboro, N. C.

The Carolina Glass Company, of Columbia, S. C., will move its plant to Jacksonville, Fla.

The Covington (Va.) Light, Ice and Storage Company is receiving bids on a 25-ton ice plant.

The plant of the Thornhill Wagon Company, Lynchburg, Va., was destroyed by fire. Loss, $96,000.

The city of Warrenton, N. C., is considering the construction of an electric power and lighting plant.

The Strasburg (Va.) Light and Manufacturing Company, recently incorporated, will build an electric plant.

The city of Cartersville, Ga., will install machinery in its electric-light plant to supply day current, to cost about $6000.

The Anglo-American Milling Company, Owensboro, Ky., has plans for the establishment of a large plant in the Central West.

WEST OF THE MISSISSIPPI

Harmony, Wash., will erect a municipal electric plant.

The city of Tucson, Ariz., will make improvements in its sewer system.

The city of Sierra Madre, Cal., contemplates improvements in its water system.

The National Woodenware Company, Hill City, Minn., will erect an addition.

The city of San Luis Obispo, Cal., will make improvements in its water system.

Lamont, Okla., voted to issue $17,000 bonds for the construction of waterworks.

The Oskaloosa (Iowa) Water Company will spend about $25,000 on improvements to its plant.

The city of Flagstaff, Ariz., contemplates improvements in its water system to cost $92,000.

The Berlin Dye Works, Los Angeles, Cal., is having plans prepared for an addition to its plant.

Mound City, Kan., will vote on the question of issuing bonds for a municipal pumping plant.

The Home Telephone Company will install a plant and extend its system in Sacramento, Cal.

The Carmichael Company, Sacramento, Cal., is making extensive additions to its water system.

The city of Bellingham, Wash., is planning for the erection of a municipal electric plant to cost $200,000.

The Beaumont Land and Water Company, Beaumont, Cal., is making improvements in its water system.

The city of Long Beach, Cal., has voted bonds for $72,900 for the improvement of its sewer system.

The St. Paul (Minn.) Showcase Company is erecting a two-story factory on Water street, near Edward.

The planing mill of the David Tozier Company, South Stillwater, Minn., was destroyed by fire. Loss, $50,000.

Equipment will be required for the new hospital building to be erected at San Diego, Cal., by Dr. D. F. Dail.

The Union Ice Company will make extensive improvements and enlargements in its ice houses in Boca, Cal.

J. Conklin and G. Maltby, San Diego, Cal., will build a furniture factory. Modern machinery will be installed.

The Alberta Lumber Company, of Denver, Colo., is looking for a site to establish a plant at San Diego, Cal.

The hoop mill, of the Hubbard Manufacturing Company, at Texarkana, Tex., destroyed by fire, will be rebuilt.

The San Antonio Water Company, Ontario, Cal., will increase the capacity of its plant; $20,000 will be expended.

The Consolidated Reservoir and Power Company, Banning, Cal., will install two power houses in early spring, 1911.

The McCloud River Lumber Company, McCloud, Cal., is making improvements in its plant and installing new apparatus.

The city of Ontario, Cal., will install a municipal water system to cost $175,000. Bonds have been voted for this sum.

The State Bank building, Pomona, Cal., will install a forced draft system of ventilation. R. H. Orr, architect, Pomona.

The J. R. Watkins Medical Company, of Winona, Minn., will erect a six-story laboratory and warehouse in Memphis, Tenn.

The Pacific Light and Power Company, North Yakima, Wash., will make improvements in its water system to cost $32,000.

The Doernbecker Manufacturing Company, Portland, Ore., has taken out a permit for a $10,000 addition to its furniture factory.

The Davies heirs, San Francisco, Cal., will erect a hotel at Sutter and Kearney streets, to cost $300,000. Equipment will be required.

W. F. Holt, Calexico, Cal., will build a cold-storage plant. A creamery establishment in connection with this is contemplated.

The Twin Peaks Mining Company, Duncan, Ariz., will build an extensive power plant at Yorf station, for use at its mines.

The Southwestern Sugar and Land Company, Phœnix, Ariz., contemplates the erection of a beet-sugar factory at Calexico, Cal.

Steam-heating and ventilating apparatus will be installed in the new apartment house to be erected by F. N. Craig, at Los Angeles, Cal.

The Hanford Water Company, Hanford, Cal., will soon begin the construction of a new substation in the northern section of the city.

The Riverside Dairy Company will erect a new building at Ninth and Mulberry streets, Riverside. Modern appliances will be installed.

The Valley Ice Company, Bakersfield, Cal., will soon be in the market for machinery for its new plant; the building is now being constructed.

The Federated Cleaning and Dye Works, Los Angeles, Cal., is building an addition to its plant to be used as a dry-cleaning department.

T. J. Stevens, San Francisco, Cal., has taken out a permit to erect an ice-cream factory at Los Angeles, Cal. Equipment will be required.

The Columbia Theater Building Company, San Francisco, Cal., will erect a hotel at Mason and Geary streets. Equipment will be required.

William Laudahan, Pasadena, Cal., is at the head of an enterprise to erect a factory at Los Angeles, Cal., for manufacturing a patent concrete tie.

Equipment will be required in the California Trades School to be erected at Sacramento, Cal., by the Trades School Commission of that city.

The Southern California Sugar Company, Santa Ana, Cal., has purchased property at Oceansides, Cal., and contemplates the erection of a sugar factory.

The treasurer of the Soldiers' Home, Sawtelle, Los Angeles county, Cal., will receive bids until January 7, 1911, for furnishing laundry machinery required.

The Washington Steel and Iron Company, Spokane, Wash., has commenced the construction of a plant at Leavenworth, Wash., for the manufacture of tool steel.

The Pasadena Furniture and Carpet Company, Pasadena, Cal., is planning to build an addition. Modern equipment will be installed; plans are being prepared.

The packing house of the San Dimas Orange Growers' Association, at San Dimas, Cal., was destroyed by fire. Loss, $70,000. The plant will be immediately rebuilt.

The city of Richmond, Cal., contemplates the installation of a modern street-lighting system. The Richmond Light and Power Company will reconstruct its present plant.

The University of California contemplates the expenditure of about $5,000,000 for new buildings and improvements; $150,000 of this will be allowed for a fire protection and water system.

All the gins of the Imperial Valley Oil and Cotton Company, El Centro, Cal., will be equipped with 100-horsepower gasolene engines in 1911. Sixty horsepower, now used, are inadequate.

The Pacific Light and Power Company, Walla Walla, Wash., will install new machinery in its power house on the Walla Walla river, to replace that recently destroyed by flood.

State Forester Homans, of California, and the University of California, at Los Angeles, will open a wood experimental station at

Santa Monica, Cal. A dry kiln and modern apparatus will be installed.

The Hamilton Supply Company, El Centro, Cal., is erecting a new building to be completed in January, 1911. The company will erect a cold-storage plant in the near future, and install a barley and feed mill.

The Northern Idaho & Montana Power Company has purchased property at Springfield, Ore., and will soon commence the erection of a power station. About $150,000 will be expended upon machinery for the plant.

CANADA

The plant of the Rat Portage Lumber Company, Winnipeg, Man., was destroyed by fire. Loss, $200,000.

MINING

The Nevada-Utah mine, at Pioche, Nev., will install new equipment.

The Coan mine, Grass Valley, Cal., will install a new 10-stamp mill.

The Prudential mine, at Grass Valley, Cal., is planning for extensive operations.

The Nevada Hills mine, at Fairview, Nev., is installing a 100-ton milling plant.

The Arizona Colorado Copper Company, Clifton, Ariz., will erect a 100-ton concentrator.

The Northwestern Metals Company, Helena, Mont., is building a plant for the treatment of ores.

The King-Nevada mines, at Pioche, Nev., will soon be in the market for a concentrating plant.

The Mesa Rica Mining Company, near Sahuaripa, Sonora, Mexico, is erecting a 10 stamp mill.

The Pacific Smelting and Refining Company is building a smelting plant at Guaymas, Mexico.

The Madizelle mine, Prescott, Ariz., in the Sierra Prietta mountains, is planning extensive operations.

The Bunker Hill mine, at Jackson, near Redding, Cal., is building an addition of 20 stamps to its mill.

The Commodore Consolidated Mines Company, operating near Goldfield, Nev., will install a gasolene hoist.

V. S. Griffith, of Tucson, Ariz., will build a rock-crushing plant at Tempe, Ariz. Equipment will be required.

The Bolanos mines, in the Bolanos district, State of Jalisco, contemplate the installation of a 500-ton reduction plant.

The Diamondfield Black Butte Mining Company, Goldfield, Nev., contemplates the erection of a reduction plant.

The Austin-Manhattan Consolidated Mining Company, Austin, Nev., will double the capacity of its reduction plant.

The Gold Bar mine, of the Consolidated Company, near Goldfield, Nev., contemplates the erection of a reduction plant.

The Hornsilver Mining Company, operating near Salt Lake City, Utah, is planning for the erection of a concentrating mill.

Jose Moreno, Alamos, Mexico, is planning extensive development at his new mines, the Esperanza and San Jose, in Sonora, Mexico.

The Mammoth Copper Company, Kennett, Cal., operating in the Balaklala district, Cal., contemplates enlarging its capacity in the near future.

The Southern Nevada Reduction and Smelting Company contemplates the erection of a smelting plant at Sahurita Junction, near Tucson, Ariz.

The Magistral-Ameca Copper Company, operating in Ameca district, State of Jalisco, Mexico, will increase the capacity of its reduction plant.

W. C. Peay, operating the Crown Point, Cactus Springs, near Goldfield, Nev., is installing a gasolene hoist and making additional improvements.

The Plomosas Mining Company, Chihuahua, Mexico, will soon install a roasting furnace to magnetize zinc and will add an addition to its concentrating mill.

A smelter will be erected at the Twin Buttes Junction, near Tucson, Ariz., by the Twin Buttes Mining Company, or the El Paso Smelting and Refining Company.

The Pittsburg Company, Grass Valley, Cal., will increase the capacity of its mill 10 stamps. The company is also making additional improvements in its plant.

W. G. Blakely, operating in the Chemehuevis mountains, near Prescott, Ariz., is starting a 5-stamp mill upon his property and contemplates extensive development.

The Shasta Belmont Company, operating the Graham mines, in the Copper City mining district, near Oroville, Cal., contemplates extensive developments and improvements.

The Sonora Copper Smelting Company, operating near Noria, Mexico, and now installing a new smelter, contemplates increasing the capacity in the near future; it is also planning to build a concentrating plant above the smelter.

BUSINESS ITEMS

The Vonnegut Hardware Company, Indianapolis, Ind., will separate its machinery department from the rest of its business January 1, 1911, and will operate it under the name of the Vonnegut Machinery Company, as a branch of the Vonnegut Hardware Company. The Vonnegut Machinery Company will be located in the building formerly occupied by the Francke Hardware Company, 43 to 45 South Meridian street. The sales organization will include Messrs. Anton Vonnegut, Charles Rassmann and C. B. Williamson.

TRADE CATALOGS

Joseph T. Ryerson & Son, Chicago, Ill. Catalog. Power presses. Illustrated, 22 pages, 9x11 inches, paper.

Oneida Steel Pulley Company, Oneida, N. Y. Catalog. Steel and wood pulleys and specialties. Illustrated, 48 pages, 6x9 inches, paper.

Ford Chain Block Company, 628 Race street, Philadelphia, Penn. Pamphlet. Tribloc chain hoists. Illustrated, 12 pages, 3½x6 inches.

The Yale & Towne Manufacturing Company, 9 Murray street, New York. Pamphlet. Chain blocks and electric hoists. Illustrated, 24 pages, 3½x6 inches.

Eugene Dietzgen Company, 214-220 East Twenty-third street, New York. Catalog. Drawing materials and surveying instruments. Illustrated, 556 pages, 6x9 inches, cloth.

FORTHCOMING MEETINGS

Society of Automobile Engineers, annual meeting, January 11 and 12, New York City; C. F. Clarkson, secretary, 1451 Broadway, New York City.

The National Civic Federation, eleventh annual meeting, January 12-14, New York City; D. L. Cease, secretary, 1 Madison avenue, New York City.

National Metal Trades Association, annual meeting, April 14, 1911, New York City, Hotel Astor. Robert Wust, commissioner, New England building, Cleveland, Ohio.

American Foundrymen's Association, annual convention, Pittsburg, Penn., May 23 to 26, 1911. Richard Moldenke, secretary, Watchung, N. J.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. S. Clark, secretary, 141 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Philip Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

Philadelphia Foundrymen's Association; meetings first Wednesday of each month, Manufacturers Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

WANTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care, 505 Pearl street, New York, will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

MISCELLANEOUS WANTS

Caliper catalog free. E.G.Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Work for screw machines and gear cutter. Box 775, AMERICAN MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery designed; drafting, tests, reports. Reliance Eng. Co., 113 Beekman street, New York City.

Wanted—Good lines for Pacific coast by experienced and well knwn machinery salesman. Box 286, AMERICAN MACHINIST.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Large English firm of machine tool importers having showrooms and offices in Great Britain, France, Germany, Italy, India and Japan is wanting good agencies for machine tools of all kinds. Box 189, AMER. MACH.

Belgium—A leading firm for the construction of steam engines in Belgium, having first class machinery of the latest design and a perfect business organization is prepared to manufacture engineering specialties. Address Box 254, AMERICAN MACHINIST.

Partnership wanted by experienced steam and mechanical engineer in good equipped machine shop in or near Chicago; expert designer on marine, Corliss and high speed engines, turbine compressors, rotary pumps, condensers, hoisting engines, mining and general machinery; highest references. Box 253, AMERICAN MACHINIST.

Uptodate machine shop; owner partially disabled, now manufacturing a well known line of patented tools, sold to largest supply houses at home and abroad; will sell whole or in part, consolidate with manufacturer of a similar line, or join with active progressive party with equal capital. Inquiries strictly confidential, full details given and will be requested from interested parties. Box 269, AMERICAN MACHINIST.

HELP WANTED

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Wanted—A tool and diemaker familiar with uptodate methods of manufacturing adding machine or other small accurate parts for a floor inspector and assistant foreman in our manufacturing department. Box 287, AMERICAN MACHINIST.

Wanted—A designer; the advertiser, one of the largest automobile concerns in the country, not located in Michigan, has an opening for an experienced and practical designer who has made good in the past; the applicant must have a knowledge of foreign and domestic practice; state age, experience and salary expected; a good opportunity for a first class man. Box 282, AMER. MACH.

Opportunity—Superintendent or foreman, assembly room Chicago factory, good pay to start, great future for common-sense hustler, not over forty years; must be worker, able to handle men and women, show them how to work, get out big quantities at low cost made right; prefer young man employed in similar capacity in big concern; do not expect to know our line; will teach right man; give full particulars first letter. Box 295, AMERICAN MACHINIST.

MASSACHUSETTS

Head draftsman and designer, experienced on rotary printing presses and folders. Box 132, AMERICAN MACHINIST.

MICHIGAN

Wanted—Experienced assemblers and mounters for machine tool work; steady work and good wages to the right men; ideal shop conditions. Grant & Wood Mfg. Co., Chelsea, Mich.

MINNESOTA

Wanted—An experienced, high grade machine shop superintendent, one that can handle men and get the best possible results out of the equipment, in a plant situated in the Middle West; will pay good salary to man that can make good. Address stating age, references, etc., Box 296, AMER. MACH.

MISSOURI

Superintendent for plant of 200 employees in a large western city; competent to design dies and devise methods for the production of metal parts of medium high class; to master the details of the other branches of the factory and to assume full control; we want a high grade man for a high grade position; no other will do; give full details in reply; strictly confidential. Box 263, AMERICAN MACHINIST.

NEW JERSEY

Wanted—First class printing press designers, draftsmen and detailers; good position for men of ability. Hall Printing Press Company, Dunellen, N. J.

Wanted—A first class printing press mechanic, to fill position of inspector and foreman of assembling floor; must be a trained mechanic with experience in determining accuracy at work, and its requirements in fitting and operation; a man of judgment who will assume responsibility. Hall Printing Press Company, Dunellen, N. J.

NEW YORK

Wanted—Young man for erector and demonstrator of high grade line of machine tools; splendid opportunity if competent. Box 249, AMERICAN MACHINIST.

Wanted—First class lathe hands for gear blank work; steady employment; state age, experience and wages desired. Box 283, AMERICAN MACHINIST.

Milling machine hands wanted; first-class men for Cincinnati plain and universal machines; steady employment, good wages. F.I.A.T., Poughkeepsie, N. Y.

Wanted—First class machine tool salesman, with practical experience preferred; must be alive and competent to produce results. Box 247, AMERICAN MACHINIST.

A thoroughly competent foreman to take charge of an automobile repair business; must be a thoroughly good automobile adjuster. Youngs & Co., Newburgh, N. Y.

English correspondent wanted by machine tool firm to do follow-up work; moderate salary to start; state experience, references, salary desired. Address "Bright," AMER. MACH.

Wanted—Young, active sales manager to sell machine tools and special machinery; state age, experience, references and salary expected. Box 248, AMERICAN MACHINIST.

Wanted—Two first class horizontal boring mill hands; must be competent to produce rapidly, first class accurate work; good opportunity; permanent position if competent. Box 246, AMERICAN MACHINIST.

Wanted—By large manufacturing company, an experienced salesman familiar with hydraulic and steam machinery; territory, South American countries; must speak Spanish; apply in writing, stating experience. Address "Hydrosteam," Post Office Box 824, New York.

OHIO

Wanted—Boring bar and boring mill men at once; night shift; state age and experience. The Heisler Company, St. Marys, Ohio.

Wanted—Experienced crane erectors; steady employment; give reference, state experience and name wages desired. Box 244, AMERICAN MACHINIST.

Salesman for a special line of machinery tools in a western territory; practical man with good references required. Address, with full particulars, Box 289, AMER. MACHINIST.

Wanted—Foreman screw machine department; first class man. Cleveland and Brown & Sharpe machines, principally special work; give references and state salary expected. Address P. O. Box 116, Cleveland, Ohio.

Wanted—First class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood and metal patternmakers, brass polishers, buffers, finishers, millwrights, hammermen and blacksmiths, who wish to increase their opportunities, to register with the free Employment Department of the National Metal Trades Association, New England Building, Cleveland, Ohio.

PENNSYLVANIA

Sales manager by a concern in eastern Pennsylvania, manufacturing ornamental and builders' iron work; must have executive ability with knowledge of estimating and costs; state age, qualifications and amount of salary expected. Box 271, AMER. MACHINIST.

The Monotype School is maintained to train young men to meet the constant demand for operators of our type casting and composing machine; these operators do so well that we receive more applications for places than can be filled; these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves, and mention this paper. Lanston Monotype Machine Co., Philadelphia.

WISCONSIN

Expert tool designer, having shop experience as well as technical training in pressed steel work to take charge of tool drafting room for large stamping plant in Milwaukee; unusual opportunity for an ambitious and capable man; state salary and past experience. Box 166, AMERICAN MACHINIST.

SITUATIONS WANTED

Classification indicates present address of advertiser, nothing else.

MICHIGAN

General storekeeper, thoroughly experienced, desires change; location immaterial. Box 264, AMERICAN MACHINIST.

Superintendent or foreman of drop forge department; fifteen years' experience and can give best of reference; will go anywhere, East or Middle West. Box 238, AM. MACH.

NEW JERSEY

Superintendent or foreman of wood pattern maker in all classes, heavy or light marine or stationary, with years' experience; best of references. Box 291, AMERICAN MACHINIST.

NEW YORK

Machine tool salesman covering Greater New York, at present employed, wishes to make a change; manufacturer preferred. Box 273, AMERICAN MACHINIST.

General foreman desires change; first class organizer, with executive ability; up to date on modern methods; excellent references. Box 293, AMERICAN MACHINIST.

Estimator on machinery, castings, plate work, boilers, piping and structural steel, desires change; high grade references; capable salesman. Box 297, AMERICAN MACHINIST.

A highly efficient mechanic, with technical education, and inventive ability, wishes position taking charge of experimental shop, either with work of purely mechanical or electrical character. Box 298, AM. MACH.

A young uptodate toolmaker, 19 years' experience, first-class on all kinds of tools and experimental work, also held position as inspector and had charge, wish to make a change. Box 294, AMERICAN MACHINIST.

Foreman, 34, now engaged; medium or heavy work; thoroughly conversant with piece work and uptodate methods; electrical or general machinery; references from present employer. Box 266, AMER. MACHINIST.

Machine designer, 27, expert mechanic, broad experience in designing, manufacturing and layout of tools and special automatic machines for twist drills and general tools, desires position; will go anywhere. Box 285, AMERICAN MACHINIST.

OHIO

Wanted—To act as manufacturer's agent, commission only; selling machinery, machine shop tools and specialties and supplies; also electrical specialties. "Commission," AM. MA.

Responsible position by man of 30, at present employed as designer; capable of designing car, building model and devising means for production; well versed with gasolene engines, automobile construction and shop practice. Box 299, AMERICAN MACHINIST.

Engineer, 32 years old, graduate of a German technical college, 10 years' practical experience, steam engine pumps, tools and mill weighing, used to control of men of different nationalities, possessor of several languages, desires appointment as superintendent or head foreman. Box 250, AMER. MACHINIST.

PENNSYLVANIA

Draftsman, experienced on gas engines and producers up to 200 horsepower, desires position. Box 275, AMERICAN MACHINIST.

Position as superintendent or factory manager, by technical graduate, with 15 years as draftsman, estimator and cost accountant. Box 290, AMERICAN MACHINIST.

Superintendent, expert mechanic, best experience in designing, manufacturing and layout of tools, specialty, increasing production, salary, $3000, want position requiring brains and ability. Box 292, AMER. MACH.

Draftsman: age 23; International Correspondence School student; three years' experience at tracing and detailing machine tools and other heavy machinery; four years' machine shop experience. Box 284, AM. MACH.

Machine designer and production specialist, with 20 years' extensive experience, desires position with responsible firm; thoroughly conversant with foundry and machine shop costs; if you want maximum production at minimum expense, let me supervise your plant; best references. Box 274, AM. MACH.

WISCONSIN

Drop forging, technical and practical mechanic, executive, 10 years as die sinker, foreman and superintendent of drop shop, understand board, steam hammer bulldozer and forging machine work, age 37, open for an engagement January 1. Box 261, AM. MACH.

FOR SALE

For Sale—General machinery repair shop business, now running; price, $2500; reasons, none better; A-1 opportunity for good machinist. Address A. D. Coss, Lima, Ohio.

For Sale—One patent and one patent pending on heavy machine tools; no competition, some in operation; will sell for cash, or part cash, balance as royalty. Box 193, AM. MA.

For Sale—Successful uptodate plant, located in splendid city in Ohio, operating automatic screw machines in the production of special screws, nuts, etc.; $16,000 required; control owned by general manager and treasurer whose salary is $2700 can be purchased for $3000; an unusual opportunity for a man of ability with $3000 who can secure $13,000 outside capital. Box 251, AMER. MACHINIST.

An opportunity to start a machine shop; we offer one of our departments for sale, the one used to establish our business; it is small and profitable work, but as we are devoting ourselves to heavier work, we offer to sell for $2000, all the drawings, patterns, and stock of finished and partly finished parts and rough material (inventories over $3000), circulars, electrotypes, special machinery and fixtures, and an established trade. Address Sipp Machine Company, Paterson, N. J.

Talks With Our Readers

By the Sales Manager

You'll get this number on the eve of what is to most of us the happiest period of the year.

We want to extend to you the greetings of the Christmas season and wish for you and those dear to you all the joy and good luck that you wish for each other.

* * * *

Our readers are found in practically every civilized country on the top of this good earth.

And we like to think of them as something more in their relation to us than buyers of what we have to sell, more than absorbers of the information which is found in our editorial and advertising columns.

* * * *

Ours is a mutual-aid society of the very highest type, and the expressions of cordiality and good will which come to us in the daily mail cheer us on to give you the best that's within our power.

* * * *

Moreover, in view of the international character which the American Machinist has with its American, English and German editions and the resulting interchange of information, we are doing something toward that better understanding among the peoples of the earth, the importance of which is so apparent.

* * * *

A Merry Christmas to you all.